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PIPE LINE INDUSTRY

NOVEMBER
1961

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A Special Report...

MODERN DESIGN AND AUTOMATION

PREVENT DEHYDRATOR FOULING
Electrostatic Precipitator Cleans NGL 40

COMPRESSOR CASE HISTORY
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CHECK LIST
An Easy Solution to Your ACT Problems 48

SUPER INSULATOR
Lead-Vinyl Sheath Quiets Regulator Noise 50

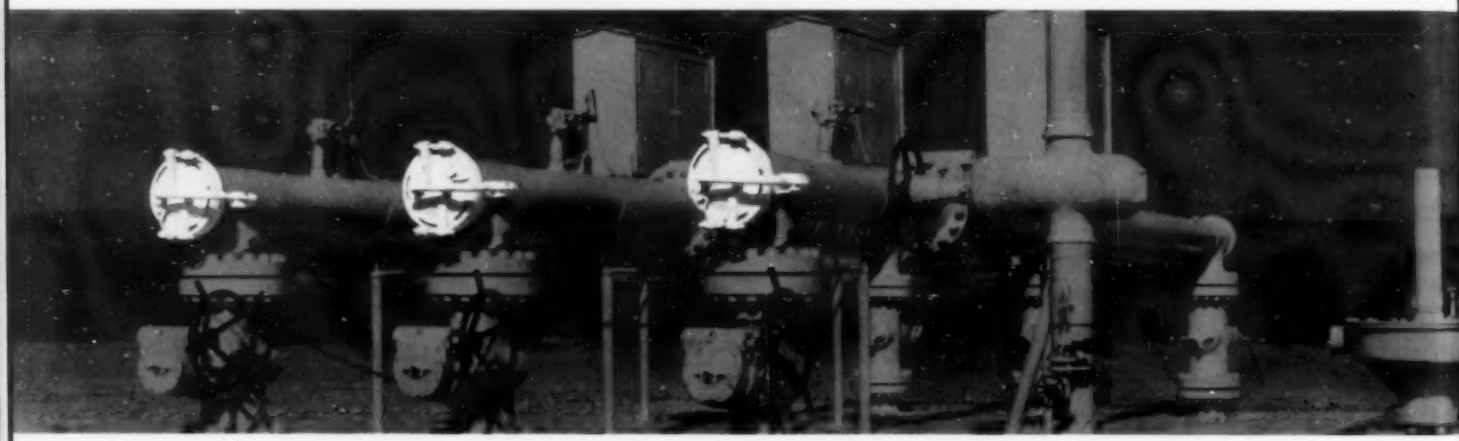
PROGRAMING THAT PAYS
Cut Power Cost on Crude or Product Lines 51

FROZEN HOLE-IN-THE-GROUND
A New Way to Store Liquefied Natural Gas 73

SUBSCRIPTION PRICE $2 PER YEAR • SINGLE COPY PRICE 50 CENTS

Read "between the pipelines"

UNIBOLT Hinged Closures started a new trend in pipeline scraper traps . . . greatly simplified the sending and receiving of pigs. Release only two bolts and this closure swings open and shut on a sturdy hinge. The self-sealing resilient gasket seldom, if ever, needs replacing.



These are UNIBOLT Hinged Closures on a gas pipeline meter manifold. They permit easy access to the meter runs for inspection and cleaning.

(Left) Gas pipeline blowoff head equipped with UNIBOLT Closures on a cantilever hinge for easy opening. A bleeder plug is provided for safely relieving pressure that may leak thru the riser valve. (Right) UNIBOLT Welding Neck Couplings in a products pipeline manifold. The cross-overs are equipped with a half-coupling which interchanges with blanking plugs on the risers. This arrangement eliminates many valves and insures against commingling of products.

UNIBOLT

THORNHILL CRAVER CO.

P. O. Box 1184, Houston, Texas

PIPE LINE INDUSTRY

A GULF PUBLISHING COMPANY PUBLICATION

November 1961 Vol. 15, No. 5

CONTENTS and Quick Look

To help you put first things first, scan these time-saving digests, checking ☑ those you want to read first.

MODERN DESIGN AND AUTOMATION

Electrostatic Precipitator Removes Corrosion Products from NGL Line

☐ At its West Texas Benedum station, Phillips keeps dehydrators for natural gas liquids from fouling by electrostatic "knockout." Fresh water was added upstream from the dehydrators and mixed thoroughly with the products stream; electrostatic precipitator coalesces water, removing FeS particles ranging from one-half to 10 microns in size. "C" factors for the line downstream have been held at a steady, high level; "two-week" scraper run schedule and corrosion inhibitor injection have been discontinued.

By Leonard E. Lee..... Page 40

Outline for Automatic Compressor Station Design

☐ Here is a logical approach to the engineering problems inloved in designing controls for reciprocating compressor stations. This follows an actual design which is now in operation.

By A. C. Winter..... Page 43

Check List for A.C.T. Installations

☐ This check list will eliminate mistakes in design, engineering and operation. The list will enable engineers who know little about A.C.T. units to supervise their design and installation successfully. Tear out these pages, enclose in plastic sheets and you have an ideal check list for use many times..... Page 48

Lead-Vinyl Insulator Reduces Regulator Station Noise

☐ By covering the piping, valves, etc. with glass wool topped with the leaded plastic material, station noise has been reduced by about 30 decibels. This is sufficient to take the station out of the nuisance category in most instances..... Page 50

Programing Crude and Products Pipe Line Operations for Optimum Power Conservation

☐ Engineers can now substitute facts for assumptions, thanks to electronic computers. Here is the method used by Gulf Oil Corporation, which operates a high-capacity 26 and 20-inch crude line from West Texas to the Gulf Coast. There are six stations on the line with total horsepower more than 42,000.

By Paul Bancio, Jr..... Page 51

Centralized Dispatching on the Mid-American LPG System

☐ The main line portion of the system is operated from the ultra-modern central Dispatch Center in Tulsa. The designers were able to accomplish their objective in this instance, which was to provide the dispatcher with all the information he could possibly use and to make it convenient to implement this knowledge at any one of the stations.

By G. V. Rohleder and William F. Haley..... Page 56

Special Design Features That Have Paid Off on LPG Line

☐ A year's operation of the Mid-America system proves the efficiency of its design and planning. In this case, the system was designed for propane, although it transports other products as well..... Page 61

Data Transmission Simplified (Part 2)

☐ Here is a glossary of most of the common—and some of the more mysterious—terms you hear the electronics boys use when talking telemetering today. It will be a handy addition to your engineering notebook. New high-speed telemetering systems can do more jobs in pipe line operations and knowing the "language" will help you evaluate the specifications of various designs.

By F. Vinton Long..... Page 65

Rapid Reading (Part 1)

☐ If you want to improve your personal efficiency—if you want to read faster and understand more—then you'll be interested in technique presented in this fascinating three-part series. Here's your chance for a free short-course on rapid reading.

By Nila B. Smith..... Page 67

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How We Know What You Want

THERE ARE SEVERAL purposes in publishing PIPE LINE INDUSTRY. First, its *editors* have found this an interesting life that is more fun than working; at least it seems better for us than field engineering, welding or pipe fitting. *You readers* want a source of up-to-date, accurate and interesting information to help you do your job better, easier and cheaper. *Advertisers* (bless 'em) want some partially filled sheets of paper to present favorably their product and services to pipe line leaders. And the *publisher* wants to serve as a communicator in the pipe line patch and make a reasonable profit (he hopes).

All of these goals are good. They can work together for mutual benefit and when achieved it would be a great life for everybody. But here is the problem: how do we (and you) know whether editorial material is hitting on all cylinders. A speaker can read the faces of his audience and know immediately whether his message is getting through. But even with frequent industry contacts and field trips, editors and publishers cannot constantly sense reader response. But our publisher is no dummy (especially when it comes to finding out just what his editors have been up to) so about two and a half years ago management thought up a scheme to find out just what readers think.

Twice in 1959, three times in 1960 and twice already this year we have sent a "blind return" questionnaire to a random selection of all different kinds of pipeliners. About three weeks after publication of an issue these subscribers were mailed another copy of PIPE LINE INDUSTRY with a question form asking each one if he had not read any of the issue. He was also asked: Do you clip articles? Do you save your copies of PLI? How many times do you refer back to a given issue before you have finished reading it? Do you regularly route your copy of PLI? To how many? He was also asked to indicate his field of interest: crude oil, products, gas transmission and whether engineering, operations or construction. And finally, he was asked to mark with a thick black grease pencil (enclosed) those page or portions of pages that he recalled reading.

Results of these surveys may give you some profitable reading ideas. The "feedback" has already led to a number of improvements in PLI and we are planning more. More than 82 percent of the readers reporting said that they clipped articles from PLI and so the new "slotted binding" to make clipping easier was introduced in the September issue of PLI.

In the seven surveys a total of 985 readers marked the issue of PLI and returned it with their completed questionnaire. Perhaps you were one of them. Here are the averages from those surveys:

Some 90.5 percent indicated that they had read at least part of the issue and 42.4 percent said that they had not finished with it some three weeks after they had received their regularly mailed copy. Probably the most flattering result was that 84 readers out of every 100 said that they saved copies of PLI.

And 88 percent of you said that you referred back to a given issue more than once and the average was three references; 59 percent of you route your copy of PLI and the average number of "other" readers was 4.4. (we guess that the 0.4 man is reading over somebody's shoulder).

To know what to say to any audience, you have to know who they are. The seven surveys told us that 38 percent of you are interested in crude oil pipelining, 39 percent in handling products, and just under 63 percent of you are gas transmission pipeliners. By activity, 59 percent named engineering, 62 percent operations and 72 percent construction. (Even as poor as we were in calculus, we know that there can't be 193 percent of you; but many of you have multiple interests).

Pipe Line Panorama, presented by Associate Editor Don Lambert each month, was the top editorial department in the magazine, rating from a strong 61 percent readership up to a top of 76 percent. Engineering Editor Don Taylor's *Ideas for the Future* were read and remembered by some 60 percent of these PLI readers and *Pipe Line Hints* rated 55 percent in one survey. Don De Pugh's *What's Happening in Pipe Line Construction* rated a strong 62 percent reader recall (top survey 72.5 percent) and the *Proposed Pipe Line Construction* pages ran a good 50 percent readership. *What's New In Equipment* rated a very good 47 percent reader recall, even though it is well back in the magazine. This confirms both the need for pipeliners to keep up with the latest in equipment and the suppliers' effectiveness in presenting informative equipment announcements.

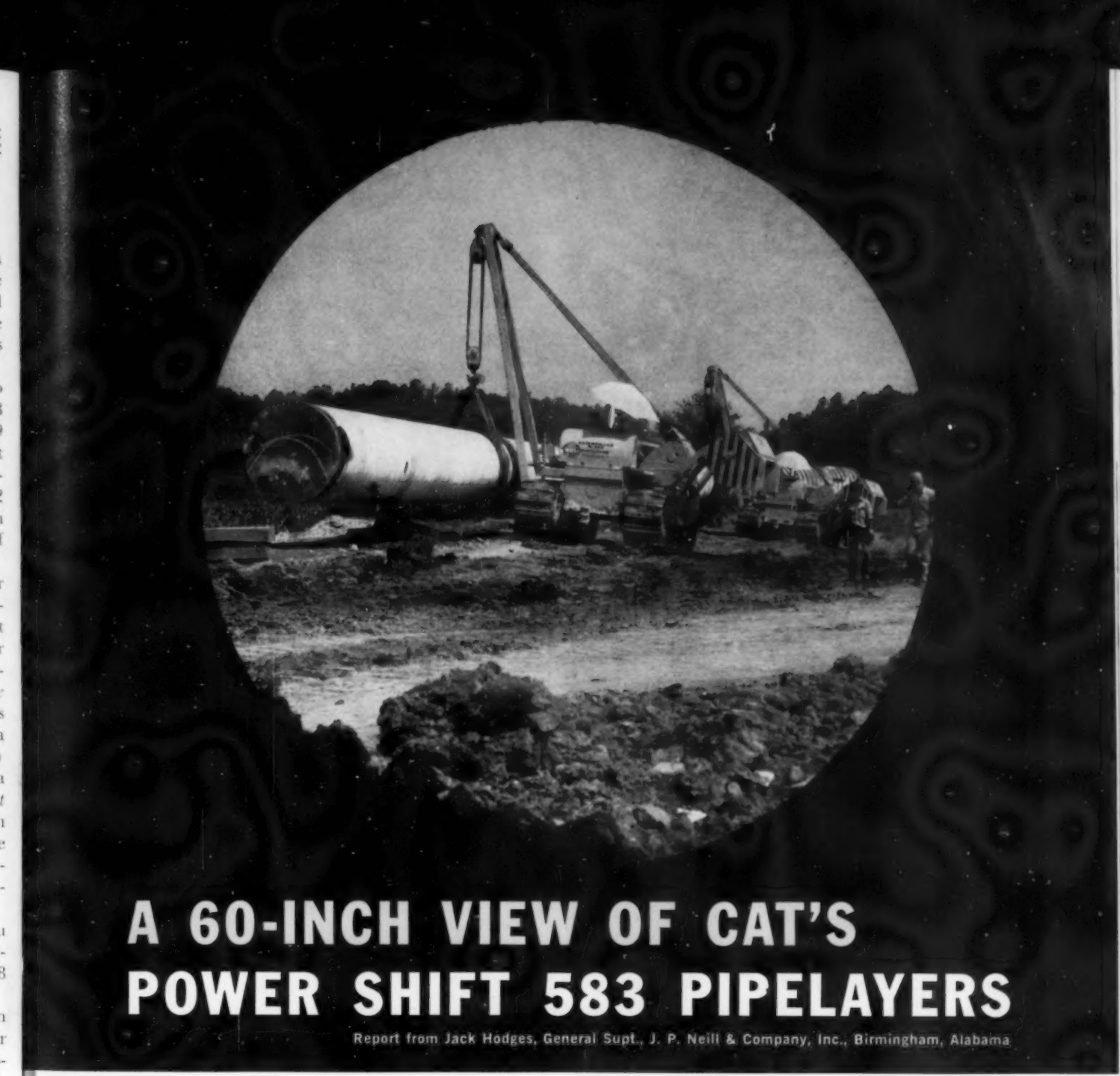
If past surveys are fair indicators almost half of you will miss this. The *editorial page* rates just over 50 percent reader recall with the best we've ever done a 58 percent in April this year.

As you might suspect with the diversity of interest in modern pipelining feature articles vary widely in reader rating. The highest marks go to the exciting new developments that are understood by almost all readers; this is especially true of construction methods. A feature story on stringing pipe with helicopters in the June 1960 PLI rated 82.6 percent recall with readers, tops for any editorial material in any issue tested so far.

Advertisements are read, too, and remembered by a large number of readers. As you would logically expect line pipe drew the top score. A leading pipe supplier's ad rated 51.0. There is high interest and retention in ads covering a variety of supplies and services.

Our purpose in devoting the effort and expense to these inquiries has been to improve PIPE LINE INDUSTRY along the lines your responses suggest. We realize that this has imposed upon the time of busy men. To the almost 1,000 readers who have helped we say *thanks again* and to those who we may ask the future favor—*please give us your ideas.* In that way you both help us to serve you and the pipe line industry better in the future.

Melvin A. Judah



A 60-INCH VIEW OF CAT'S POWER SHIFT 583 PIPELAYERS

Report from Jack Hodges, General Supt., J. P. Neill & Company, Inc., Birmingham, Alabama

"The power shift on the new Cat 583 allows split-second shifts when juggling 60" pipe. The operator can handle the draw works levers and change travel speeds by nudging the *single* transmission lever with his forearm—impossible otherwise. When climbing these grades, he can smoothly drop to a lower gear to keep the load moving. Machines with other type transmissions must stop and slow down the operation."

Jack Hodges is talking about performance from the two 583s working on the industrial water line from Fort Smith Dam to Birmingham, Ala. They're handling 60" pipe, weighing 20,000 lb. per 40' joint, over rough terrain with grades up to 67½ degrees. "It's the kind of job that brings out the best and shows up the worst in any machine. That's why the 583s look so good."

The beautifully engineered combination of 235 HP, 137,000 LB. LIFT CAPACITY, POWER SHIFT TRANSMISSION, and an unmatched 21" GROUND CLEARANCE equip the 583 for heavy work in mountains or swamps . . . work that other machines can't handle over ground where other machines can't go. No wonder men who work with the 583 talk long and favorably about it.

For your own record-setting production *with low cost* . . . see your Caterpillar Dealer.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

CATERPILLAR

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HEAVY-DUTY PIPELAYERS FOR THE HARD WORK

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for Pacific Gas Transmission Company and Alberta Natural Gas Company

A solid state pipeline control system from Dresser Electronics, SIE Division,

will allow maximum personnel efficiency and optimum operation for the 722-mile Pacific Northwest portion of the new Alberta-California pipeline system.

Rock-steady reliability is guaranteed by use of transistors and semi-conductor diodes—no moving parts, **no known failure mechanism.** Digital "computer-language" techniques eliminate transmission errors, provide computer compatibility. Functional groupings of **plug-in modules** insure easy and logical maintenance—all Dresser/SIE system **users continue employing their regular maintenance personnel and key operating people.**

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Accelerate your cost reduction program.

Call the pioneers in solid-state pipeline control...

Dresser/SIE equipment is also in use or being built for: Colorado Interstate Gas Company, Continental Oil Company (Cherokee Pipe Line Co.), Mountain Fuel Supply Company, Magnolia Pipe Line Company, Continental Oil Company (Glacier Pipe Line Co.), Tennessee Gas Transmission Company and Nordberg Engines.

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PIPE LINE INDUSTRY and The PIPE LINE CATALOG for the oil and gas pipe line industry.

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Indexed by Engineering Index

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for all services

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"Our Ford Trucks save us 2.3¢ per mile"

says Mr. R. M. Johnson, Vice President, Cosden Petroleum Corporation, Big Spring, Texas

"Our latest six-month truck operating expense summary shows that Ford Trucks cost only 8.6¢ per mile to run compared to 10.9¢ for our total truck fleet. This average covers all of our production, refining, marketing, pipeline and administration trucks. Since these figures include all maintenance and repair work, durability and reliability are two big factors that contribute to lower operating expense.

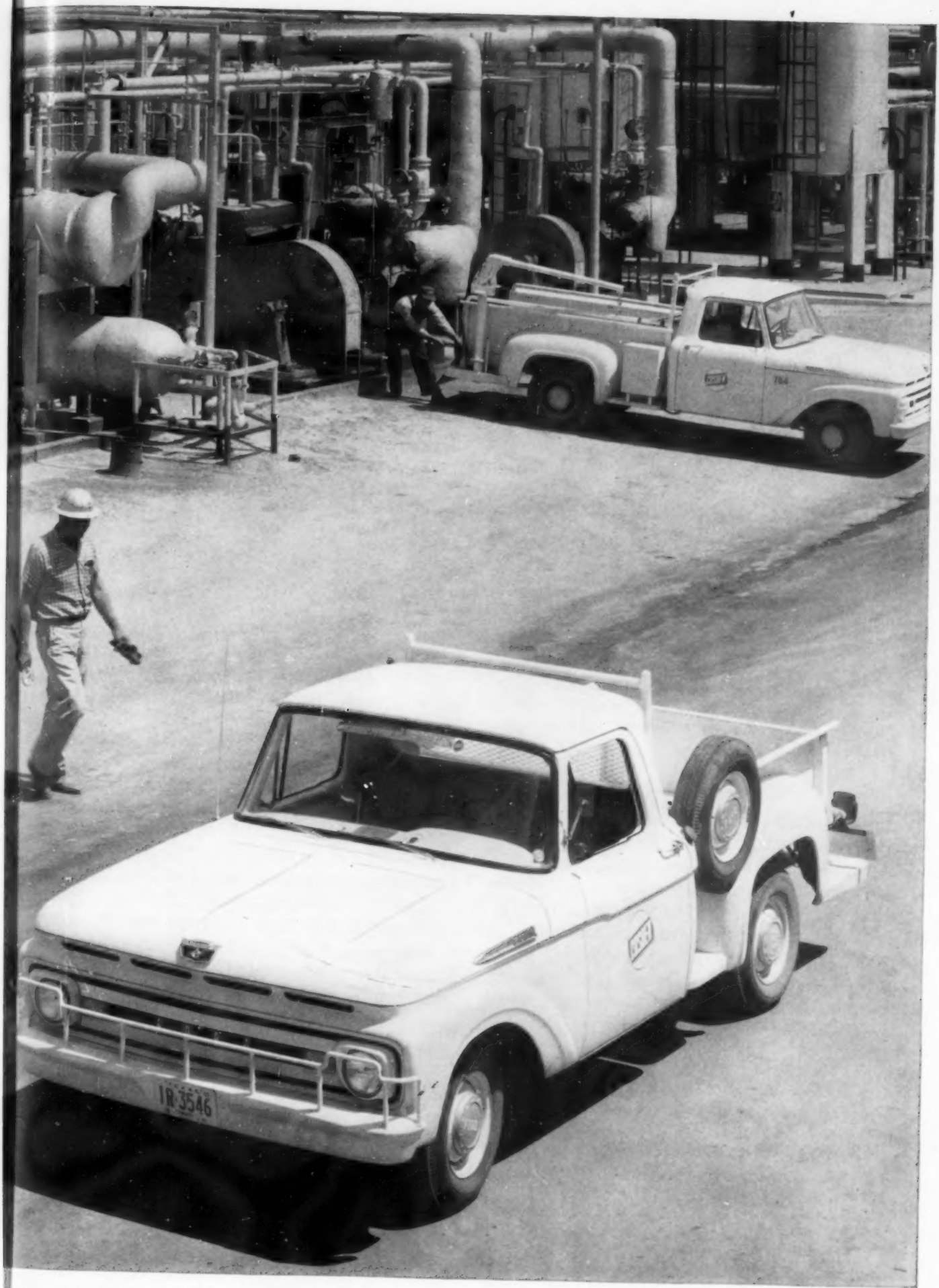
"Ford Trucks lead the fleet in these respects, too. A good case in point is our 1956 Ford F-800 winch truck. Its odometer reads just over 24,000 miles *but the engine has run an average of 7 hours a day, 5 days a week for the last 6 years.* Actually there are well over 8,000 hours on the engine so far, and without a major overhaul . . . this is service that we feel is the equivalent of 300,000 hard miles.

"Also, successive cost analyses have shown that we save money on maintenance and repairs by having all this work done at local Ford Dealer's. This system does away with our need for carrying an expensive parts inventory and reduces our own shop facility and manpower needs. Naturally, our 750 retail outlets do all the routine lubrication, washing and fueling for the fleet."

Solid testimony that Ford's full-time economy only starts with low price!

FORD TRUCKS COST LESS

PRODUCTS OF Ford MOTOR COMPANY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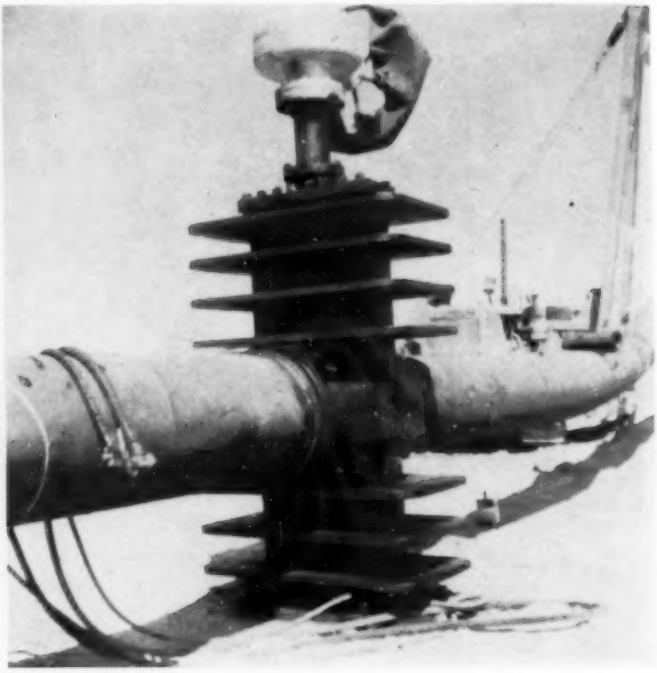
EL PASO NATURAL GAS COMPANY PROTECTS LINE VALVES WITH ROSKOTE COLD-APPLIED MASTIC

Roskote cold-applied mastic was spray-applied to 30" valves by El Paso Natural's personnel at Grants, New Mexico. Risers and support legs were coated with Roskote and wrapped with Royston Glas-Wrap for additional mechanical abrasion protection.



On the El Paso Natural Gas Company line being laid at Fort Stockton, Texas, by Western Pipeline Company, all 20" valves were spray-coated with Roskote cold-applied mastic.

You get superior protection against the most severe field corrosive agents with Roskote cold-applied mastic. Valves, risers, line pipe, tanks and other structures above or below ground are coated with Roskote by spray or brush without heat, flame or toxic and irritating effect on workers. The quick-drying feature of these mastics permits early backfilling. Roskote's time-saving, cost-saving application complements its low first cost to provide you with the most economical means of long-life metal protection.

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For more data on advertised products, use cards, last page.

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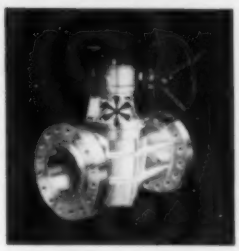

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When portable electric power is vital, you can't afford to gamble on "accident prone" parts. Only Onan offers so many safeguards against breakdown: Stellite valves, oversize bearings, shorter-stronger connecting rods and crankshafts. Equally important, *only* Onan is Performance Certified to deliver *all* the power promised by its nameplate.

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Onan electric plant still delivers full power after 12,197 hour test—equal to 487,888 miles

A grueling endurance test that lasted one year, nine months and 12 days could not stop Onan test plant #1068. Onan engineers used this production-built unit for an endurance run—and after it was all over, it still generated the full rated power promised on the nameplate. Proof that Onan's exacting standards and production testing give you a power plant with long, dependable life built in.

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Buy *proven performance* when you buy an Electric Plant. See your authorized Onan distributor or dealer. You can depend on him for a lifetime of factory parts and service. He's listed in the Yellow Pages.

ONLY ONAN GIVES YOU THIS CERTIFICATION

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CORRECTS AND COMPENSATES FOR VARIATIONS IN temperature — humidity — barometric pressures — dust.

Under any climatic extreme the all mechanical GRAVITOMETER measures specific gravity for use in orifice meter measurement. No *controlled* or *conditioned* atmosphere is required, and there are no complicated or critical adjustments to make for atmospheric variations.

The GRAVITOMETER was designed to eliminate errors in the float-type gravitometer when variations occur in the temperature and density of the atmosphere surrounding the sample float.

The GRAVITOMETER can be installed without the use of highly trained technicians, and is easily operated and maintained. Completely automatic, it produces positive, accurate and correct specific gravity measurements.

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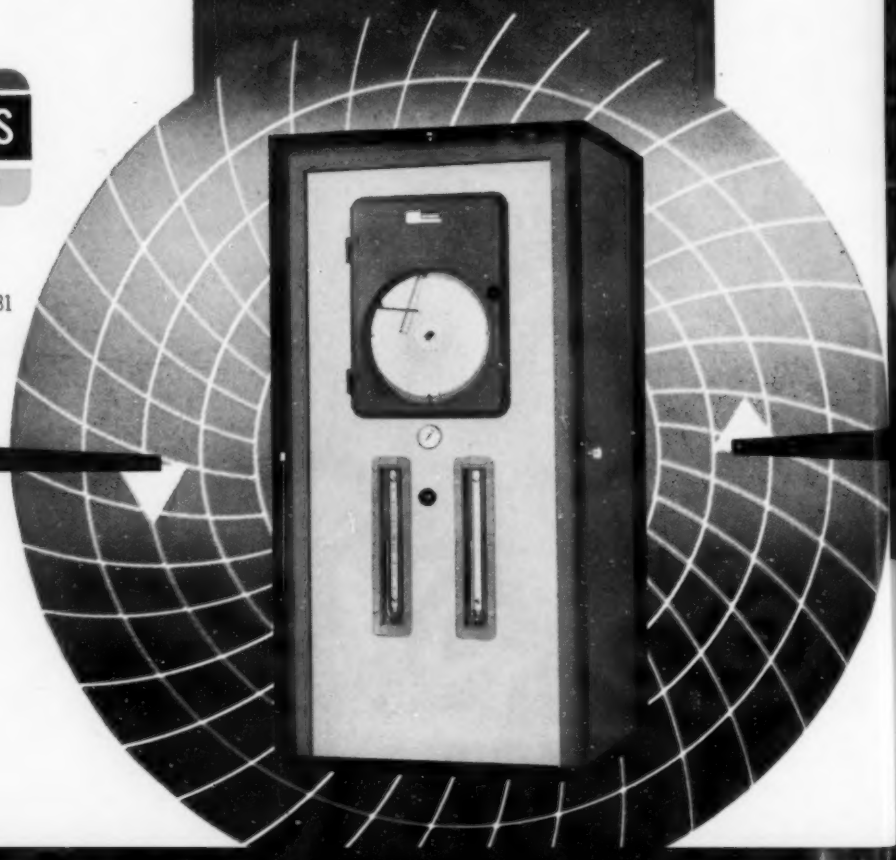
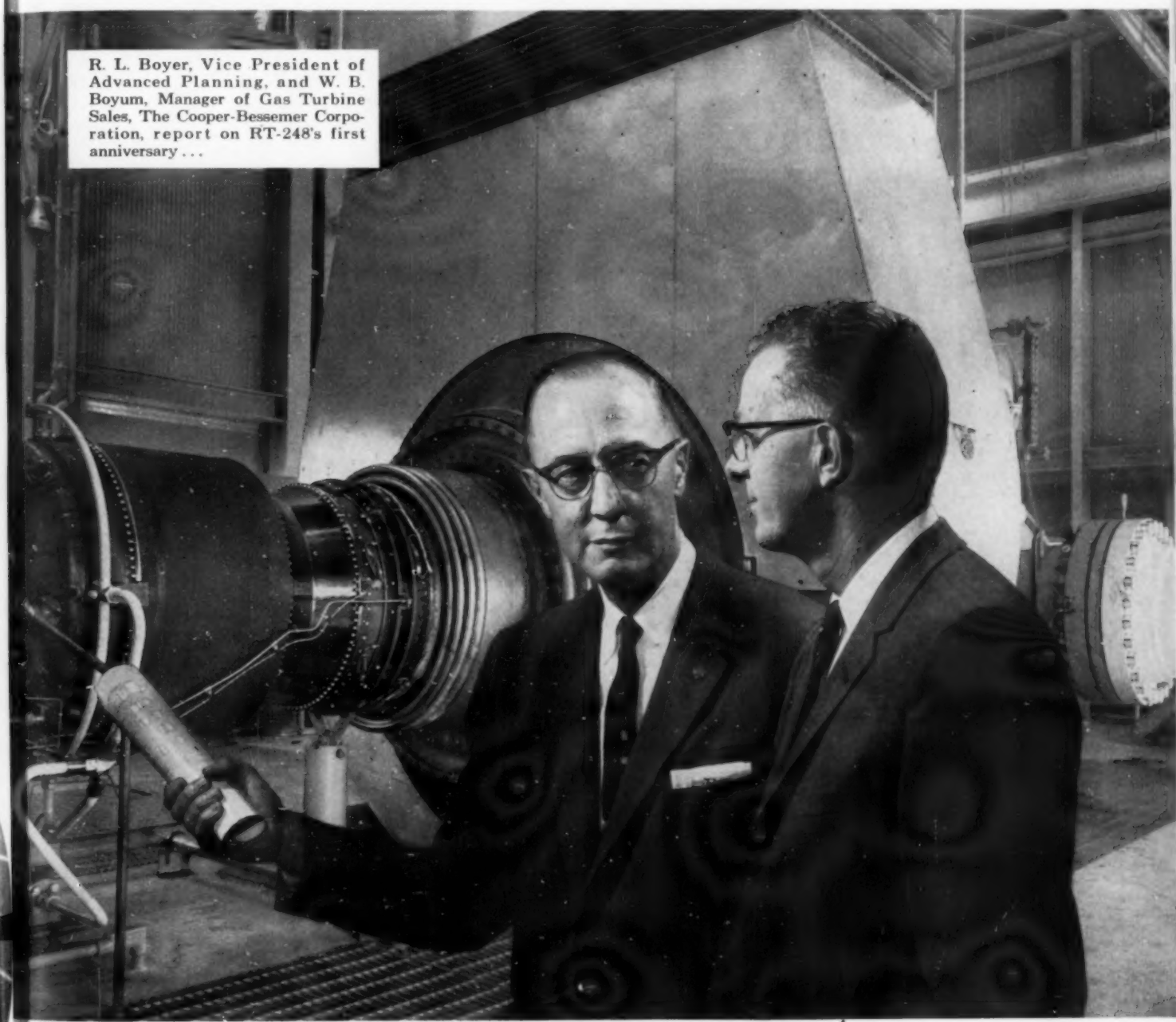


First anniversary report on world's first jet-powered gas turbine

The Cooper-Bessemer RT-248 gas turbine shown below started operation on October 31, 1960, at Columbia Gulf Transmission's Clementsville (Kentucky) compressor station of the Columbia Gas System. Here's what it proved after the first year in service:

• Unparalleled overall economy of operation, as expected. • Exceptional reliability and availability, proven by 6500 hours of heavy-duty service with average load in excess of its 10,500 hp rating. • Simplicity and ease of control. Since June 20 has operated remotely from Nashville. • High efficiency (25%) without costly, bulky regeneration equipment. • Lower overhaul and downtime expense than with other comparable prime movers. Unit exchange concept with factory reconditioning of "jet" simplifies maintenance.

The RT-248 is a joint development of Cooper-Bessemer and Pratt & Whitney Aircraft. For further information on this and other C-B gas turbines, from 340 to 15,000 bhp, for all power applications, contact our nearest office.



R. L. Boyer, Vice President of Advanced Planning, and W. B. Boyum, Manager of Gas Turbine Sales, The Cooper-Bessemer Corporation, report on RT-248's first anniversary . . .

Cooper Bessemer

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ENGINES: GAS · DIESEL · DUAL-FUEL
JET-POWERED GAS TURBINES

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but new TD-15 bo

Lowering in the pipe — the "15's" operator keeps easy control of the load with the horizontal, vertically-stacked levers. Fleeting sheaves prolong cable life by preventing piling or crushing. The TD-15 is powered by the millions-of-hours proved 6-cylinder D-554 diesel engine—that develops 105 net hp. Note how correct end-to-end and side-to-side balance takes advantage of 28 sq. ft. of plank-like flotation—to prevent miring or skidding on the soft slope!

y for most rigs—

5 *boom* "floats" *through*

—for R. L. Coolsaet Construction Co., Dearborn, Mich.

Rain poured down for days—yet, as fast as draglines could clean out cave-ins, the new International Superior TD-15 Sideboom was "lead-off" rig. The "15" handled the lion's share of walking the pipe to the trench and lowering it in.

And despite the terrific handicaps of boggy conditions, this 42-mile job of R. L. Coolsaet Construction Co., Dearborn, Michigan, went ahead. "The new TD-15 can get into tighter, sloppier holes than our other rigs," declares the foreman.

Platformed on 28 square-feet of track-on-ground flotation, the new TD-15 boom is a "mudder" from the ground up. High-clearance sideboom hinge points provide maximum clearance in soft footing. Underside design is clean. Engine and transmission guards are completely enclosed for positive protection.

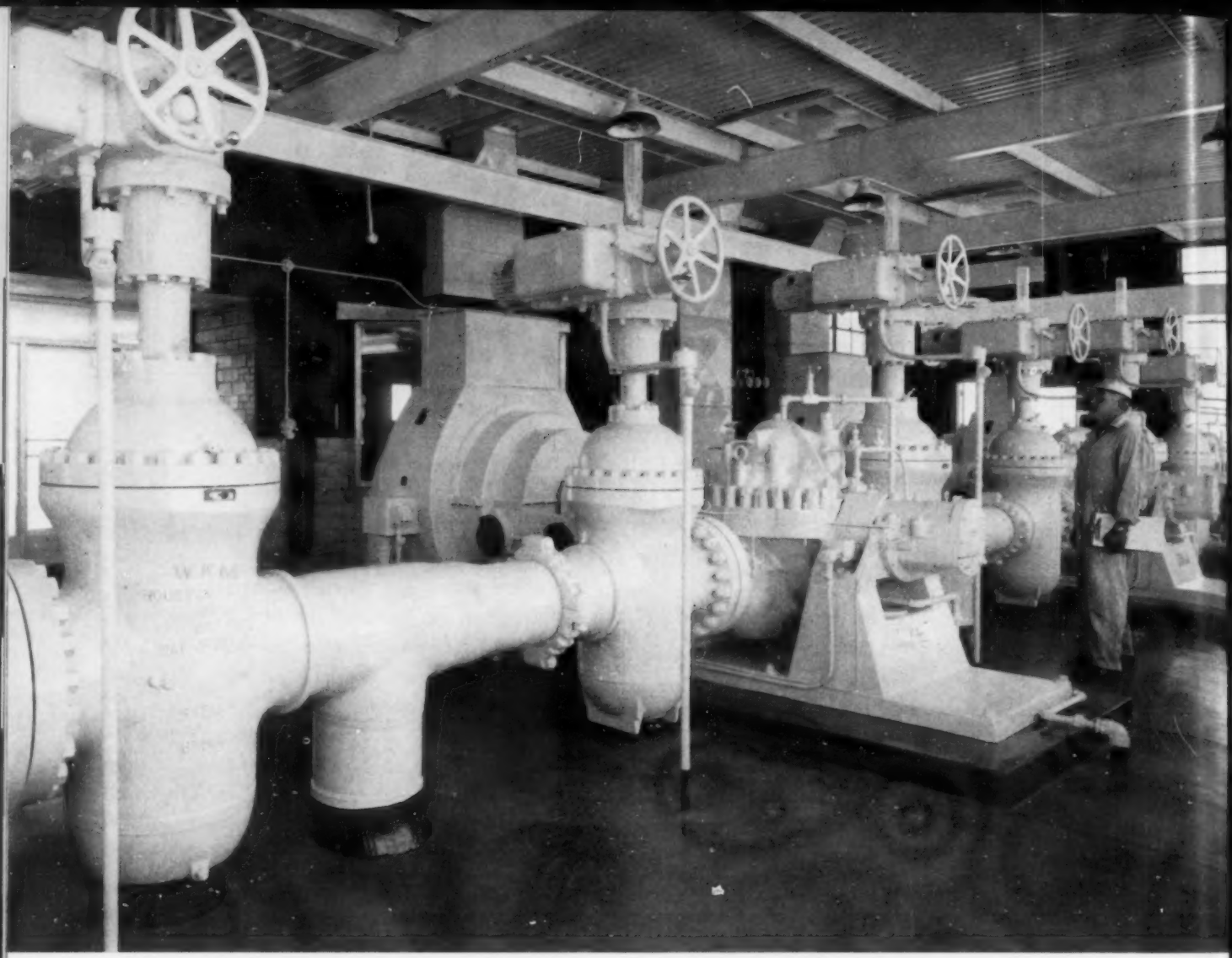
Industry-topping undercarriage strength backs the TD-15 boom's big lift: 46,500 lb. at 4 ft.! Precision-welded box beams, joined by heavy-duty steel gussets, and anchored by ¾" steel plate, form the TD-15's Dura-Roller equipped track frames.

Prove TD-15 Sideboom advantages in the toughest conditions—See how it "stacks up" against weather, terrain, and competitive rigs. Measure TD-15 capacity, lowering in pipe as big as 24"—stringing 36" pipe—doing pipeline utility and maintenance. Let your International Superior Distributor demonstrate.

International Harvester Company, Chicago 1, Illinois

INTERNATIONAL®

SUPERIOR®



YOU CAN'T BUY GREATER RELIABILITY

W-K-M Saf-T-Seal Gate Valves

The W-K-M SAF-T-SEAL Gate Valve is specified by people who demand outstanding sealing and top reliability *plus* economy. That's why five SAF-T-SEAL valves were chosen for this fully automated, 250,000 barrel-a-day crude oil pumping station.

The SAF-T-SEAL is a non-lubricated pressure sealing gate valve — its floating steel seats with Teflon inserts give positive, total contact sealing *both upstream and down, in both open and closed position.* Its basic simplicity provides a degree of reliability greater than any other similar valve. Further, when working parts become worn, new valve performance may be quickly restored by installing new parts while the valve is on the line. Other features, such as automatic relief of excessive body pressure, the efficient enclosed packing gland, the effectiveness of the valves in double block and bleed service are explained in Catalog WS 1061. Write for your copy today.

W-K-M SAF-T-SEAL Gate Valves are available in sizes from 2 inches through 42 inches. Pressure ranges: ASA 150, ASA 300, ASA 600, ASA 900.

WHEN SO MUCH DEPENDS ON A VALVE . . . *Specify* **W-K-M**

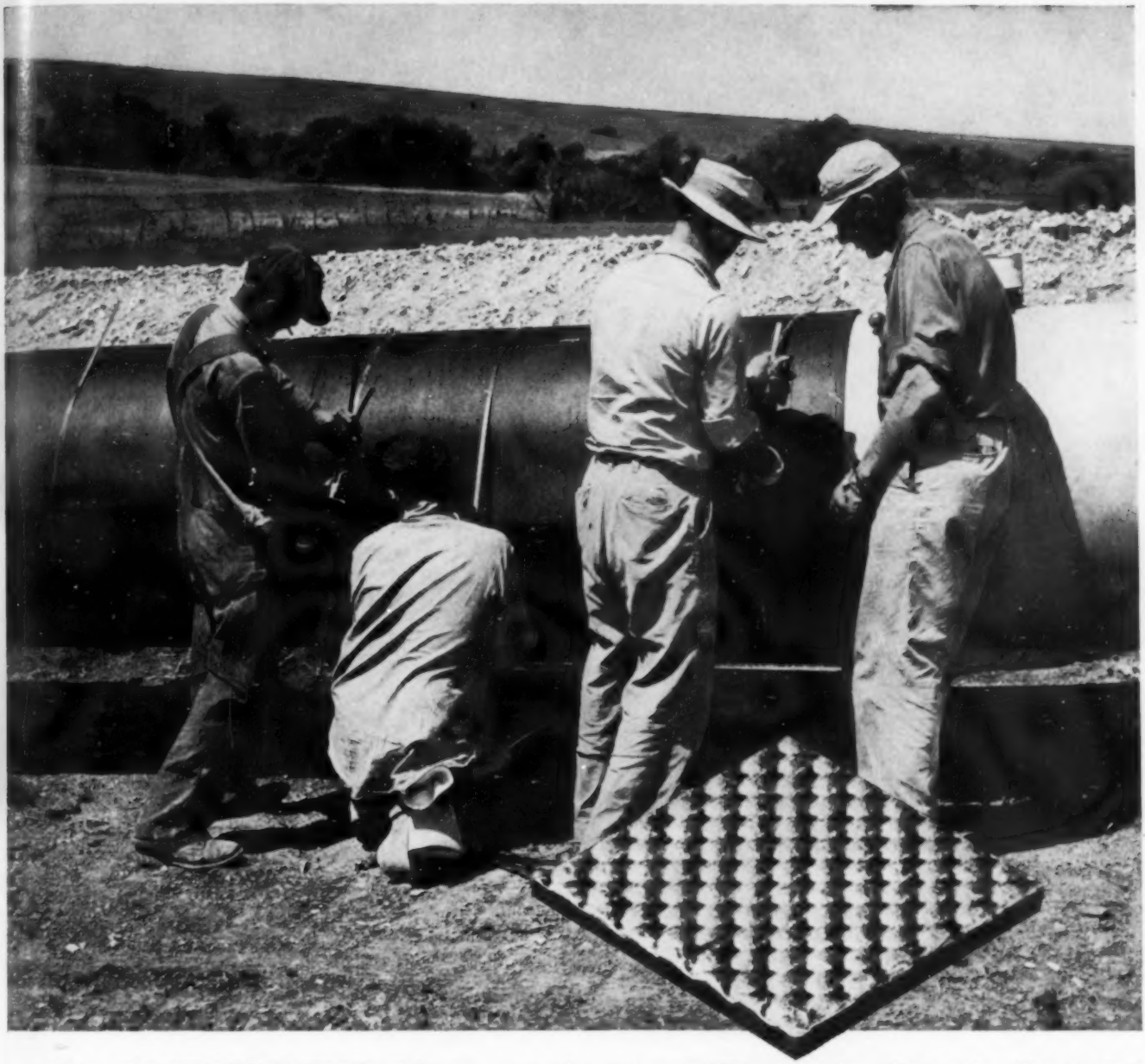
W-K-M
DIVISION

ACF INDUSTRIES

P. O. BOX 2117 HOUSTON, TEXAS

6119

WRAP UP THE JOB



with RUBEROID'S New Indented Flexible Rock Shield

Lighter Weight! Lower Freight Costs! Extra Cushioning!

Here's important news in pipeline protection! Ruberoid's new Indented Flexible Rock Shield gives your pipelines highly dependable protection against rock damage, eliminates costly dirt padding – yet features remarkably light weight. This new Ruberoid product is up to *10% lighter* than its companion product – Standard Flexible Rock Shield. Reduced weight *slashes freight costs*...application costs! And this new product provides *resilient protection* for your pipelines.

Application is simple. Ruberoid Indented Flexible Rock Shield can be applied in two pieces, or by the cigarette wrap method. Permanent placement is insured by the use of ½" or ¾" steel strapping with aluminum seals – or by the use of scotch filament tapes. Ruberoid Indented Flexible Rock Shield comes up to 60 inches wide... weight averages only 97½ lbs. per 100 sq. ft. Costs no more than Standard Rock Shield. Samples on request.

Industrial Specialty Products Division, The RUBEROID Co., 733 Third Avenue, New York 17, N.Y. **RUBEROID**

Write us for possible distributorship in your area

For more data on advertised products, use cards, last page.

Moisture removal for third magnaflux test of every length of E.W. line pipe

TEST

quality control tests make sure Youngstown line pipe won't fail in the field

Take the pipe and check the weld. Then crush an end. Burst a length. Pressure-test it hydrostatically. From ore to steel to final stenciled product, separate mechanical and visual inspections make sure Youngstown line pipe won't fail in the field.

Get Youngstown Electric Weld line pipe in sizes 6⅝" to 22" O.D. Get it in time and money-saving long lengths to 55 feet. Order Youngstown Seamless line pipe in sizes 2⅜" to 14" O.D., Continuous Weld line pipe in sizes ⅛" nominal to 4½" O.D. Get it fast, when and where you want it, through Youngstown District Offices, through any one of 900 independent pipe distributors.

Count on Youngstown for line pipe you can depend on. For gas and oil gathering, transmission and distribution lines. For product lines from petrochemical plants and refineries. For quality pipe wherever line pipe is needed. You get value and performance when you buy line pipe from Youngstown, world's second largest pipe producer.

Youngstown – growing force in steel

For complete information about Youngstown line pipe, write Dept. 18-B,
The Youngstown Sheet and Tube Company, Youngstown, Ohio.

What's new in telemetering . . .

NEW! compact receiver package that gives you everything!

New Bristol Series 670 Metameter* Telemeter Receiver is the first *truly compact* instrument that gives you every feature you need for efficient operation of central dispatching facilities.

■ **It's compact, with big performance:** Only 7" x 7⅛" panel space; yet 4-inch strip chart gives you same-size record as much larger, standard round-chart instrument.

■ **It's more versatile:** Series 670 offers you more options, far more accessory equipment than other compact or miniature instruments: one or two pens; up to 4 retransmitting slide wires (two per pen); up to 2 front-set alarm contacts and up to six easily accessible, easily adjustable alarm contacts, each with an individual scale, inside case —a total of 4 alarm contacts per pen. Up to 4 alarm lights may be panel mounted. **T.M. Reg. U.S. Pat. Off.*

■ **It's easier to operate and service:** Chart changing is a one-hand operation—*takes only seconds.* Capillary inking system can be filled from front. Chart tear-off and rewind provisions. Famous Bristol human-engineered scales and pointers. Rectilinear chart coordinates.

■ **It's easier to maintain:** Full plug-in construction, with sparkless mercury-switch disconnect, lets you replace entire instrument in seconds if need arises.

The new Bristol 670 Metameter* Receiver is available for both 5 and 15 second impulse duration systems, with a wide choice of charts for every telemetered variable. Let us send you complete data. Write:

The Bristol Company, 114 Bristol Road
Waterbury 20, Conn.
A Subsidiary of American Chain & Cable Company, Inc.

ACCO

BRISTOL . . . leader in instrumentation for the gas industry

127 AUTOMATIC CONTROLLING, RECORDING, LOGGING AND TELEMETERING INSTRUMENTS

LOWER YOUR BUCKETS

Tortured by thirst...
Yet where they drifted, the Amazon carries
its fresh water many miles to sea.
To drink, they had only to lower their buckets! Many
times all it takes to succeed is to recognize
and take advantage of the opportunities around us.
There are so many...when we *look*.

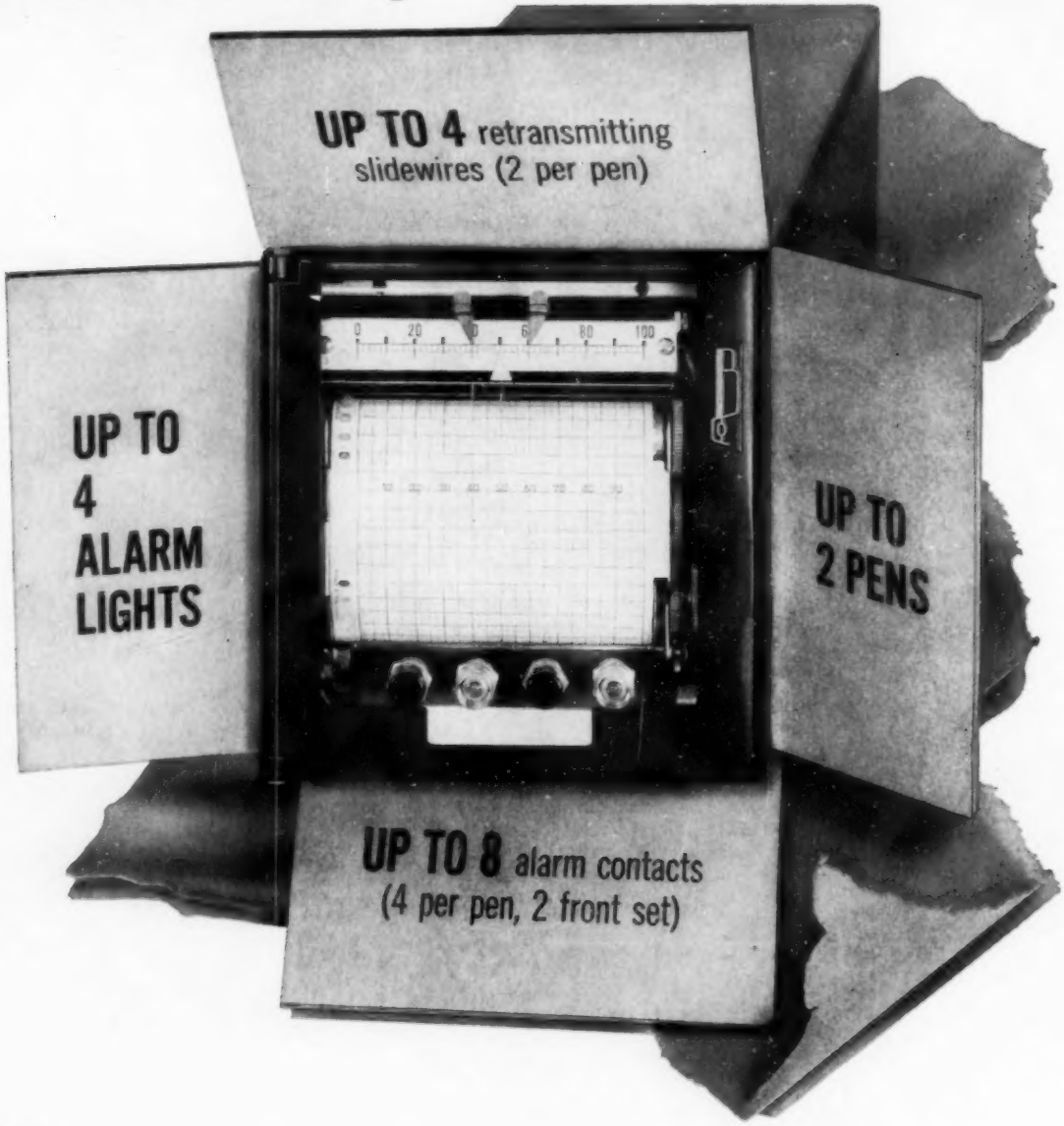
Gas and oil are where you find them. From Canada to the tip of South America our geologists probe the earth for both. Our 3000 producing wells now add to the flow of energy available to the Americas.

TENNESSEE GAS TRANSMISSION COMPANY

FROM NATURAL GAS AND OIL...HEAT, POWER, PETROCHEMICALS THAT MEAN EVER WIDER SERVICE TO MAN

HEADQUARTERS: Houston, Texas • DIVISION: Tennessee Gas Pipeline Company • SUBSIDIARIES: Midwestern Gas Transmission Company • East Tennessee Natural Gas Company • Tenneco Corporation • Tenneco Oil Company • Tenneco Chemical Company • Tennessee Life Insurance Company • AFFILIATE: Petro-Tex Chemical Corporation

What's new in telemetering . . .



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Tortured by thirst...
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There are so many...when we *look.*

Gas and oil are where you find them. From Canada to the tip of South America our geologists probe the earth for both. Our 3000 producing wells now add to the flow of energy available to the Americas.

TENNESSEE GAS TRANSMISSION COMPANY

FROM NATURAL GAS AND OIL...HEAT, POWER, PETROCHEMICALS THAT MEAN EVER WIDER SERVICE TO MAN

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Announcing:

an exciting new concept in valves

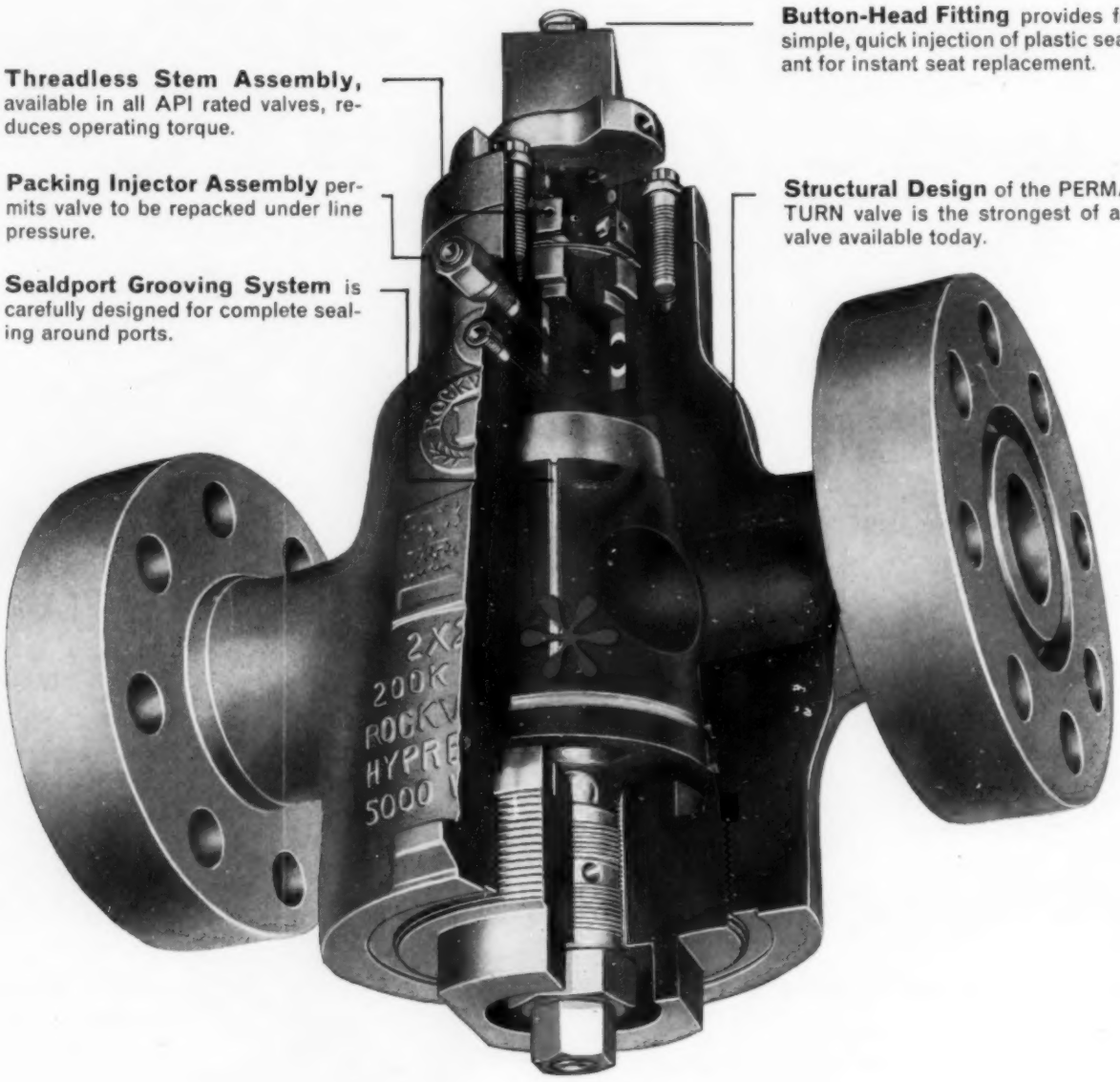
Button-Head Fitting provides for simple, quick injection of plastic sealant for instant seat replacement.

Threadless Stem Assembly, available in all API rated valves, reduces operating torque.

Packing Injector Assembly permits valve to be repacked under line pressure.

Structural Design of the PERMATURN valve is the strongest of any valve available today.

Sealdport Grooving System is carefully designed for complete sealing around ports.



THE PERMATURN HYPRESEAL DESIGN FOR HIGH PRESSURES
(available also in low pressure designs)

✻HEART OF THE PERMATURN VALVE

A unique design feature in the Rockwell PERMATURN valve is its coated plug. Selected after extensive testing during the five year PERMATURN development program, the coating material has an extremely low coefficient of friction and is applied so that it is *permanently bonded to the metal surface of the plug.*

This tenacious, durable dry film lubricant gives *permanent separation of metal surfaces* of plug and body, preventing sticking and assuring smooth, easy quarter-turn operation always. The coating is inert to all normal liquids or gases and has proved its durability, both in torture tests conducted in Rockwell research laboratories and in numerous field installations made throughout the country to confirm these results.

The Rockwell

PERMATURN

Valve

offering new reliability, ease of operation, and long life in high pressure services

Out of a background of 40 years' leadership in valve research comes the newest, most significant development of this decade: the PERMATURN valve line.

Fully tested for five years in Rockwell's own modern laboratories . . . and field-proved before introduction . . . the PERMATURN valves are the first to combine all the most wanted valve features in a full line available in all sizes, from ¼" to 36", and for all normal pressures, to 10,000 psi.

Here are some of the unique advantages offered valve users in this new PERMATURN design:

SURE, EASY 90°-TURN OPERATION

Design improvements have been made throughout the PERMATURN valve to give positive, low torque operating characteristics under all conditions. The high lubricity permanent plug coatings are an added assurance of reliable operation, even in remote locations or where infrequent attention is given the valve.

"PUSH-BUTTON" SEAT REPLACEMENT

Every time sealant is injected into a PERMATURN valve, you put a new seating surface in the valve! This infinitely soft, resilient seat is renewed from the *outside, without loosening a single bolt,* in seconds. And new automatic sealant injectors available from Rockwell further simplify this process, feeding sealant to the valve as it is required from a large reservoir.

DROP-TIGHT SEALING

The Rockwell PERMATURN valve used with a regular program of sealant replacement is the tightest valve known. And the drop-tight sealing characteristics of the PERMATURN valve are renewed with every injection of sealant, for just pennies. No need to tear down the valve to replace worn, leaking seating surfaces.

LOW COST, LONG-LIFE PERFORMANCE

The Rockwell PERMATURN valve is as close to being a permanent installation as pipe itself. Sturdy construction, trouble-free design, and the regular program of sealant injection all contribute to this long life. And "push-button" replacement of seating surfaces gives assurance that maintenance costs will be low over the life of the PERMATURN valve, too.

SEND FOR COMPLETE INFORMATION

Rockwell Manufacturing Co.
99-L N. Lexington Ave., Pittsburgh 8, Pa.

Please send me a copy of your Pocket Valve Guide to Rockwell PERMATURN valves.

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

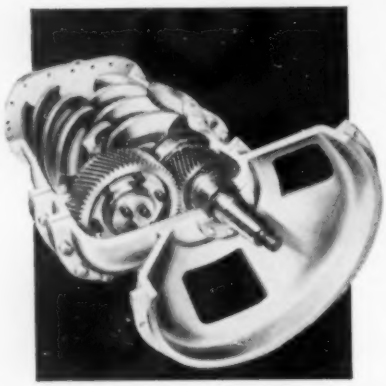
ROCKWELL PERMATURN VALVES

another fine product by

ROCKWELL

FILLS THE MEDIUM CAPACITY GAP!

ANOTHER NEW ROTA-SCREW PORTABLE READY FOR YOUR FLEET

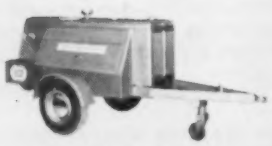


Here's cost-saving news for your medium-sized jobs. All the cost-cutting advantages . . . which Gardner-Denver Rota-Screw portables are now demonstrating on construction projects from coast to coast . . . are now available to you in a new model that delivers 365 cfm.

There's nothing to wear out in the air compression chamber . . . no contact between running parts.

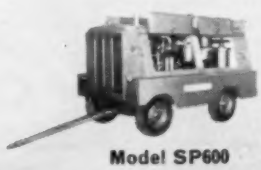
No vanes to inspect or replace • Single-stage simplicity • Instant compressed air • Automatic blowdown.

See your Gardner-Denver distributor . . . or write for details on Rota-Screw portables in capacities of 125 . . . 365 . . . 600 . . . 900 cfm.



Model SP125

Model SP365



Model SP600

Model SP900

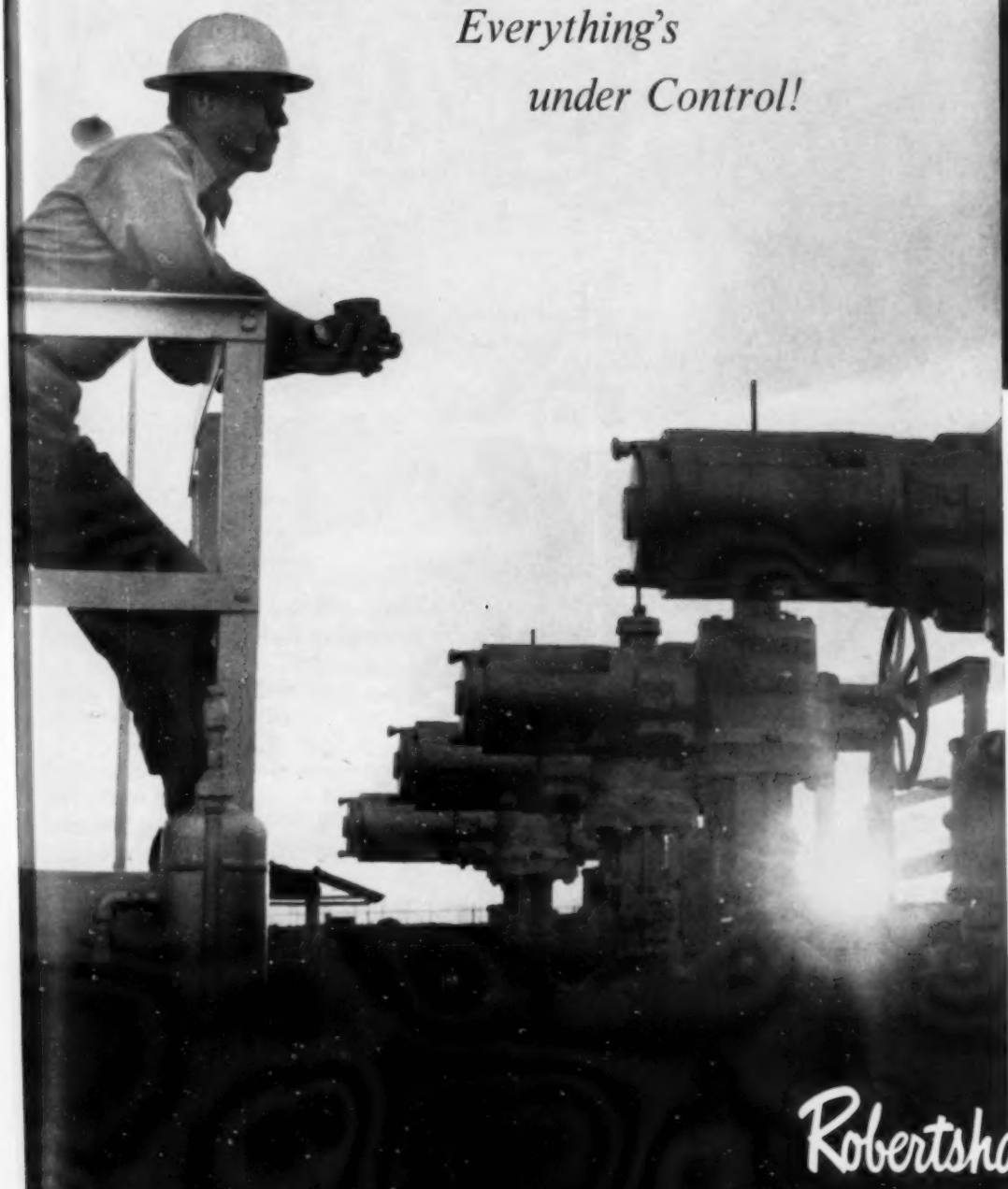
EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER-DENVER

Gardner-Denver Company, Quincy, Ill.—Offices in principal U.S., Canadian and Mexican cities
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Ave., Toronto 16, Ontario
International: Gardner-Denver International Division, 233 Broadway, New York 7, N.Y.
International Offices: Buenos Aires, Argentina; Artarmon, N.S.W. Australia; Brussels, Belgium; Rio de Janeiro, Brazil; Santiago, Chile; Barranquilla, Colombia; Lima, Peru; Ndola, N. Rhodesia; Salisbury, S. Rhodesia; Johannesburg, Transvaal.

4:55 P.M.

Everything's under Control!



ROBERTSHAW'S VIBRASWITCH MALFUNCTION DETECTOR IS ON THE JOB!

In five minutes the only maintenance man at this remote pipeline pumping station will leave for the weekend. Everything's under control. On unattended automatic equipment . . . wherever expensive rotating and reciprocating machinery deserves 'round-the-clock malfunction protection . . . specify Vibraswitch. Electrical and pneumatic signaling models that react instantly to changes in acceleration of machinery vibration . . . shutting down, alarming, activating standbys. When will your expensive machinery next break down? How costly and time-consuming will repairs be? Can you afford to be without low-cost Vibraswitch protection? Over 50 conveniently located sales-service offices. Write for address of the one nearest you.

Robertshaw

MANUFACTURERS OF ROBERTSHAW CAPACITANCE ACTUATED LEVEL MEASUREMENT INSTRUMENTS AND MICROSEN INDUSTRIAL PROCESS CONTROL SYSTEMS

Aeronautical and Instrument Division, Robertshaw-Fulton Controls Company, Santa Ana Freeway at Euclid Avenue, Anaheim, California.

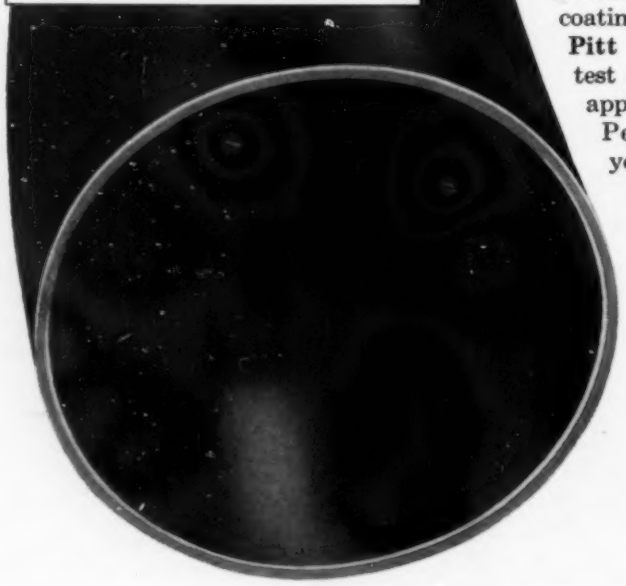
1950
PITT CHEM MODIFIED®

1954
PITT CHEM HOTLINE®

1955
PITT CHEM TARSET®

1959
PITT CHEM QUICK-DRY®

Now in development
PITT CHEM PIPELINE TARSET®



PITT CHEM

FIRST in Development of Better Pipeline Coatings!

Providing solutions to pipeline protection problems, through the development of better pipeline coatings, is one of the reasons why Pittsburgh Chemical has long been recognized a leading supplier to the pipeline industry. During the past decade Pittsburgh has developed four outstanding coal tar base coatings for the pipeline industry. These include:

Pitt Chem Modified Enamel — the original "medium range" coating, which can be applied during most seasons of the year and is able to withstand above-normal service temperatures.

Pitt Chem Hotline Enamel — a superior coating which offers exceptional resistance to penetration, puncture, soil stress and distortion and gives outstanding protection to pipelines operating in the 180°F range.

Pitt Chem Tarset — a revolutionary, cold-applied coal tar-epoxy resin coating used extensively for protecting pipeline joints, fittings, and patch work.

Pitt Chem Quick-Dry Primer — a universal primer that drys to touch in 3 to 5 minutes and permits immediate follow-up with coating and wrapping.

Pitt Chem Pipeline Tarset — extensive field and laboratory test programs are now being conducted in conjunction with the application of a new formula, cold applied, pipeline Tarset. Periodic reports on this program will be brought to your attention.

For a complete selection of performance-proven pipeline coatings . . . and for the newest and best in *improved* products for pipeline protection, you can depend upon Pittsburgh Chemical!

2035

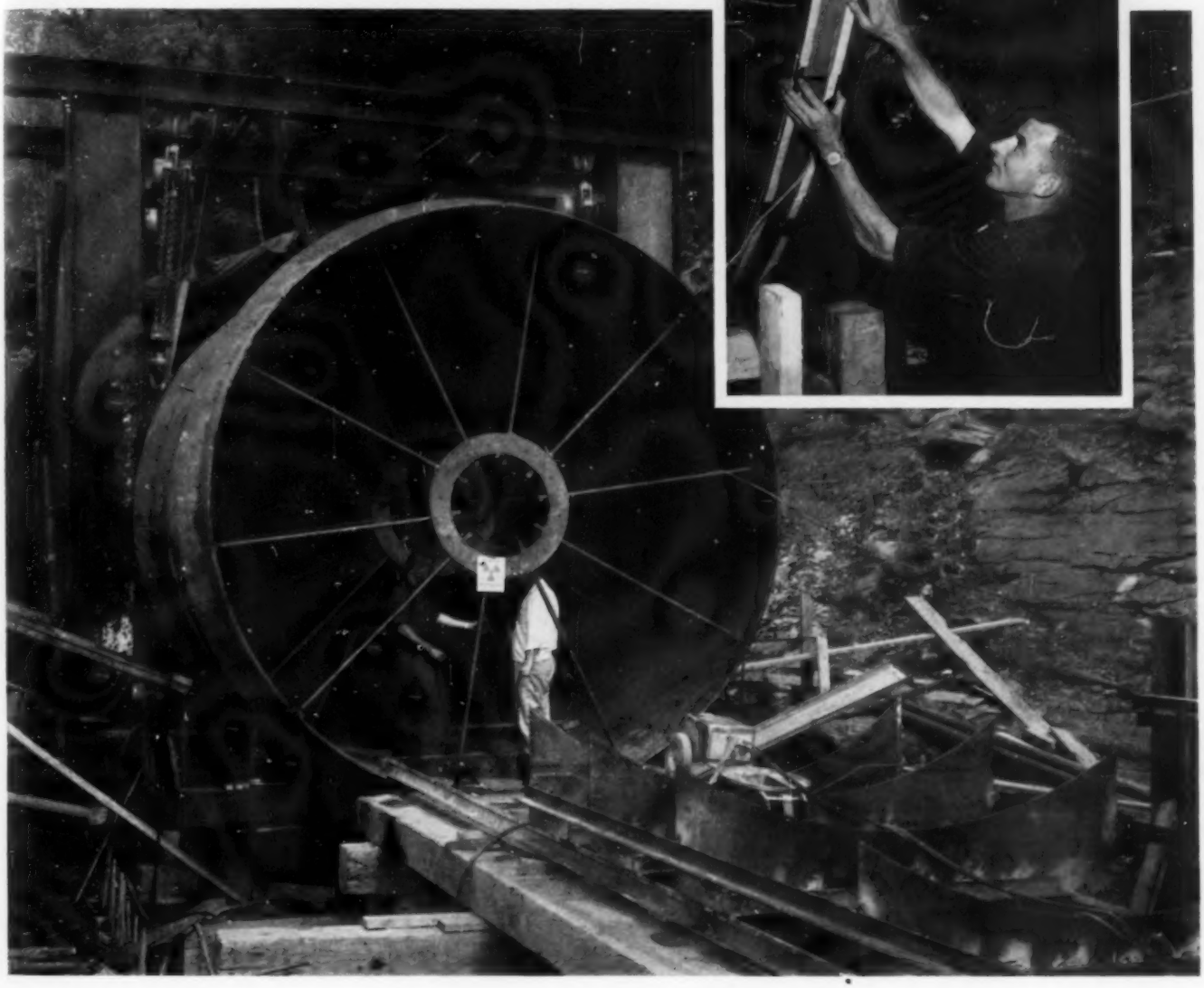
PROTECTIVE COATINGS DIVISION

PITTSBURGH CHEMICAL CO.

GRANT BUILDING PITTSBURGH 19, PA.

A Subsidiary of PITTSBURGH COKE & CHEMICAL CO.

Here, Pipeweld X-Ray Corporation technician attaches Ansco Superay 'A' X-ray film to portion of 45 foot welded seam of conduit which measures almost 15 feet in diameter.



Pipeweld X-Ray Corp. uses Ansco X-ray Film to inspect seams of Giant Conduit for New York City Water System!

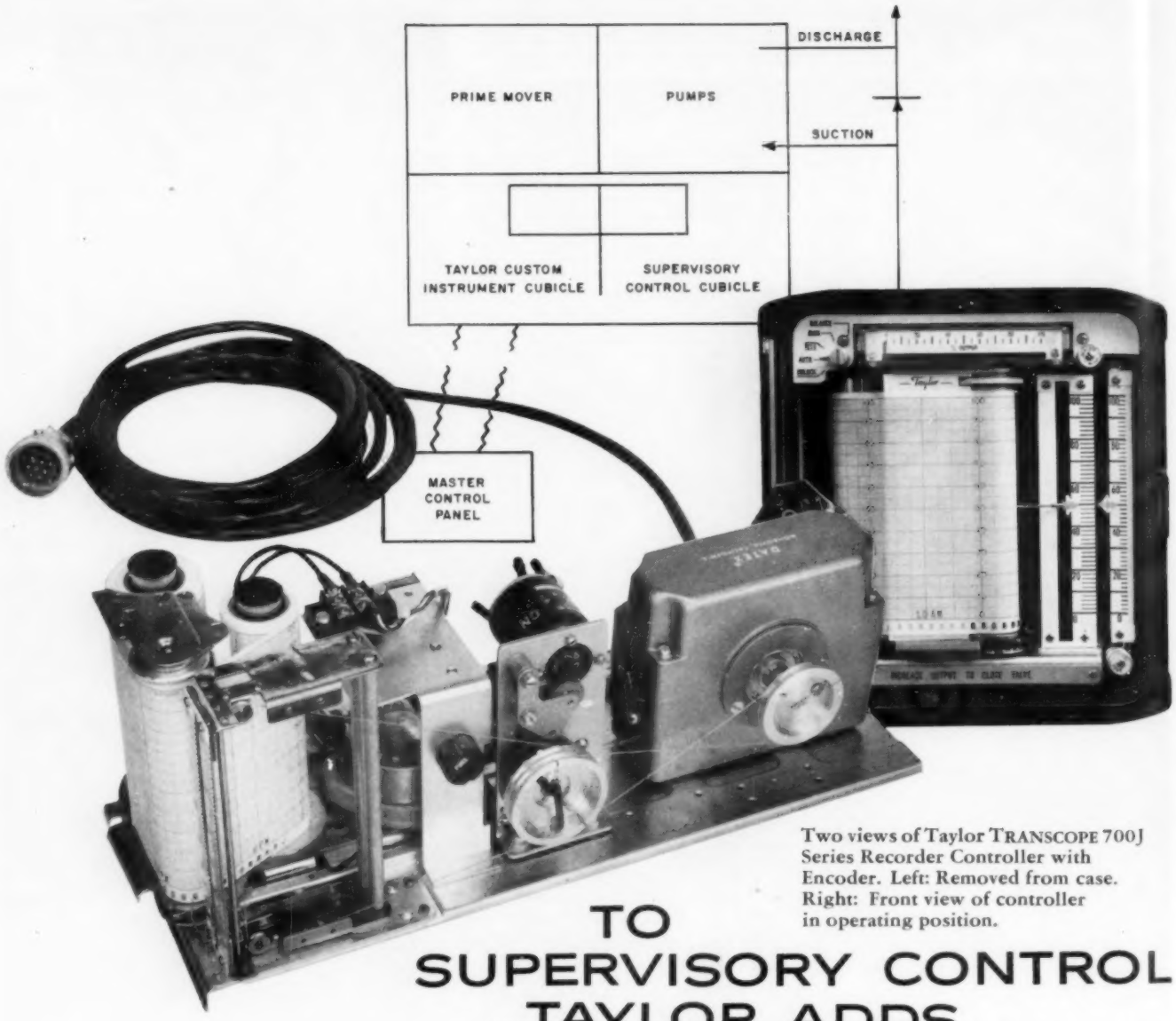
"Ansco Superay® 'A' X-ray film is the perfect answer for trouble-free radiography of welded seams in the field!" says Mr. Charles Earle, Jr., Manager of Pipeweld X-Ray Corporation of Perrysburg, Ohio. "We have found through experience that Ansco Superay films provide the uniformity and definition we require for quick, positive flaw detection."

There's a Superay X-ray film for every application. Your local X-ray equipment dealer carries a complete stock of Ansco Industrial X-ray Films and Chemicals . . . call him today about using these products in your operation.

ANSCO 70mm INDUSTRIAL X-RAY FILM

Each of the four different Ansco Superay X-ray emulsions is available in 70mm rolls from 100 feet up to 800 feet. Ansco, A Division of General Aniline & Film Corporation, Binghamton, N. Y.

Ansco
X-ray



Two views of Taylor TRANSCOPE 700J Series Recorder Controller with Encoder. Left: Removed from case. Right: Front view of controller in operating position.

TO SUPERVISORY CONTROL ...TAYLOR ADDS SIMPLICITY!

Taylor local pump station control systems are designed for simplicity . . . and economy. One good example is the TRANSCOPE* 700J Series Recorder Controller with Encoder. The exclusive servo power feature not only assures more accurate records, but also permits integrally mounted encoders. This eliminates expensive high-speed analog-to-digital converters. Because each signal is individually transmitted, the source and location of any malfunction can be readily identified.

Another benefit of the Taylor system is the smooth over-ride its standard exclusive diode circuitry provides during transitions between suction and discharge control. The "reset windup" problem is eliminated.

Taylor Pipe Line Station Control Systems are daily proving themselves efficient and economical to leading pipe line companies throughout the country. Let Taylor's specialists study your problem. Whether it's a new installation or modernization, there's a Taylor electronic or pneumatic system to fit your needs.

Ask your Taylor Field Engineer about it or write to Taylor Instrument Companies, Rochester, New York, or Toronto, Ontario.

*Trade Mark

Taylor Instruments **MEAN ACCURACY FIRST**

"WE STANDARDIZED ON CAMERON BALL VALVES"

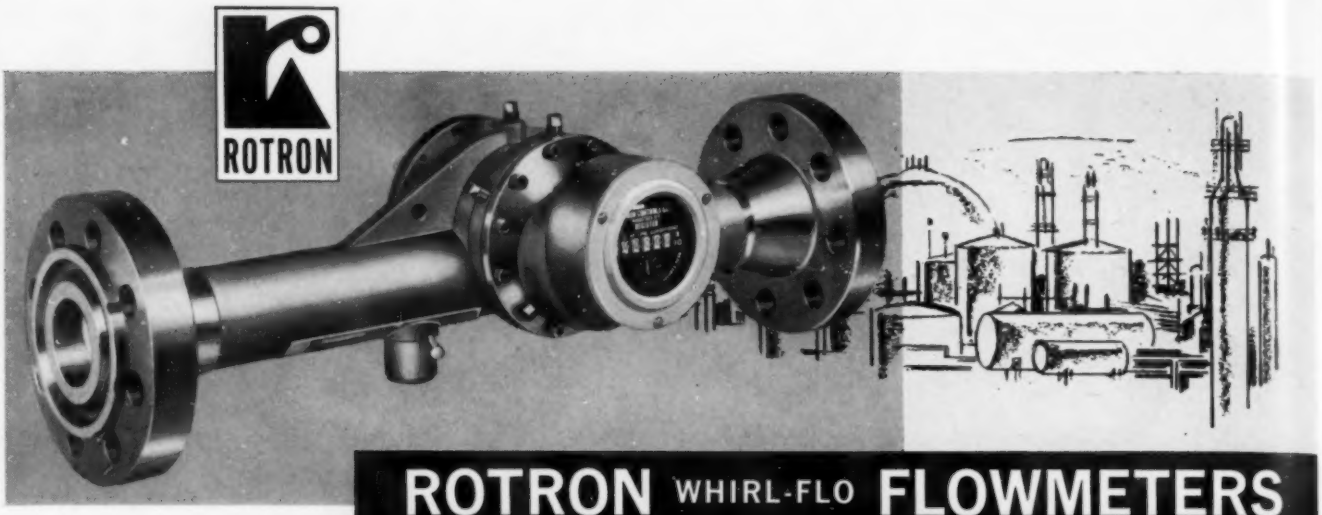
"The Cameron Ball Valve was approved by our engineers for its compact design, rotating seats to distribute wear, lack of bonnets or glands and its sealed-for-life construction. The operating men like its ease of installation, low-friction operation, lack of lubrication and lack of maintenance. Management appreciates not having to stock repair parts, the lack of down time, and the prompt delivery in a wide range of sizes and pressures . . . and the outstanding performance on our test installations really sold us." Have you carefully considered the many features Cameron Ball Valves offer?

Cameron

CAMERON IRON WORKS, INC.
P. O. BOX 1212 HOUSTON, TEXAS

CAMERON BALL VALVES

For more data on advertised products, use cards, last page.



ROTRON WHIRL-FLO FLOWMETERS

accurately and economically measure liquid or gas flow in a simple, compact, high-capacity unit

There's no substitute for results when it comes to proving product performance. And results with Rotron Whirl-Flo Flowmeters are proving to many demanding users in the petroleum, natural gas, chemical, petrochemical and food processing industries the inherent accuracy and economy of the Rotron Vortex-Velocity design. Consider the following applications, for example:

WIDE-RANGE OF APPLICATIONS

Proven applications for Rotron Whirl-Flo Flowmeters include measurement of gas produced from oil or gas wells, measurement of gas or water used for oil well injections, and metering oil. In refining and petrochemical service you will find Rotron meters used for in-process control, accounting for final production, and product blending. Chemical uses range from measurement of liquid fertilizers to LPG and other hydrocarbons, including fuel metering in jet engine test stands. Metering the flow of pineapple juice is only one of many functions in food processing. And in the power field, Rotron has proven highly efficient for peak shaving operations in gas distribution systems. Yes, the meter handles viscous fluids and liquids with suspended solids.

Experienced Rotron application engineers are ready at all times to study your specific requirements. Qualified Rotron field engineers, capable of recommending the most efficient flowmetering systems, are available at your call.

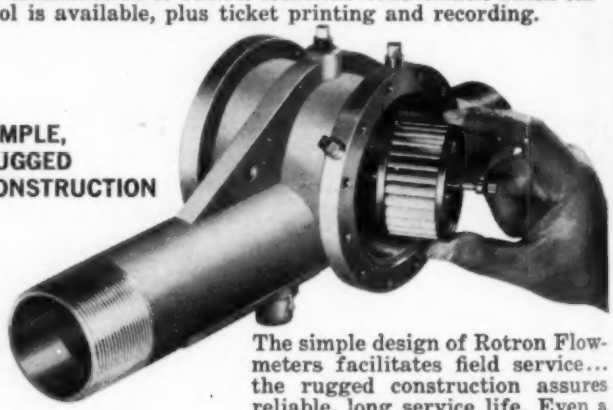
ECONOMY OF INSTALLATION AND SERVICE

The high degree of accuracy, the inherently larger capacity compared with other meters size for size, and the low installation cost, all contribute to the amazing economy of Rotron Whirl-Flo Flowmeters. Rotron is your best buy for direct totalization... no electrical power required.

VERSATILITY OF READOUT

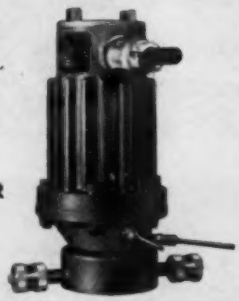
Rotron also offers direct readout of flow rate at the meter or transmission to remote locations... automatic batch control is available, plus ticket printing and recording.

SIMPLE, RUGGED CONSTRUCTION



The simple design of Rotron Flowmeters facilitates field service... the rugged construction assures reliable, long service life. Even a salesman can replace the rotor unit in 10 minutes without removing the meter from the line, without special tools.

ROTRON WHIRL-WEIGH GAS DENSITOMETER



Can be mounted directly on the Rotron Flowmeter for mass flow measurement... also adaptable to existing orifice meters for mass flow. It can also be used independently as a gas density analyzer. Uses cover a wide variety of gases.

GENERAL SPECIFICATIONS

Pressure Rating: 2-inch meters 1500 psig; 3-inch meters and larger 2000 psig.

Pressure Drop: for liquids less than 7 psig at max. flow; for gases usually less than 100 inches water at max. flow rate.

Sizes: models available from 2-inch to 16-inch for liquids or gases.

Accuracy: depends upon meter size; usually ±0.5% or better over 10:1 span. Repeatability better than ±.2%.

Standard Materials of Construction: 2-inch meter stainless steel; other sizes carbon steel; other materials available.

Connections: 2-inch meter threaded ends or flanges; 3-inch meter and larger flanges.

Capacity: liquid capacities range from 10 to 100 gpm for the 2-inch meter to 1400-21,000 gpm for the 16-inch meter; typical gas capacities range from 100-1000 scfm at 100 psi in a 2-inch meter up to 20-150 mmscfd in a 16-inch meter at 100 psi.

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For high pressure, high temperature and high speed pumping, an extra safety factor is built into this DVMX Pump—*the safety of a quality product!*

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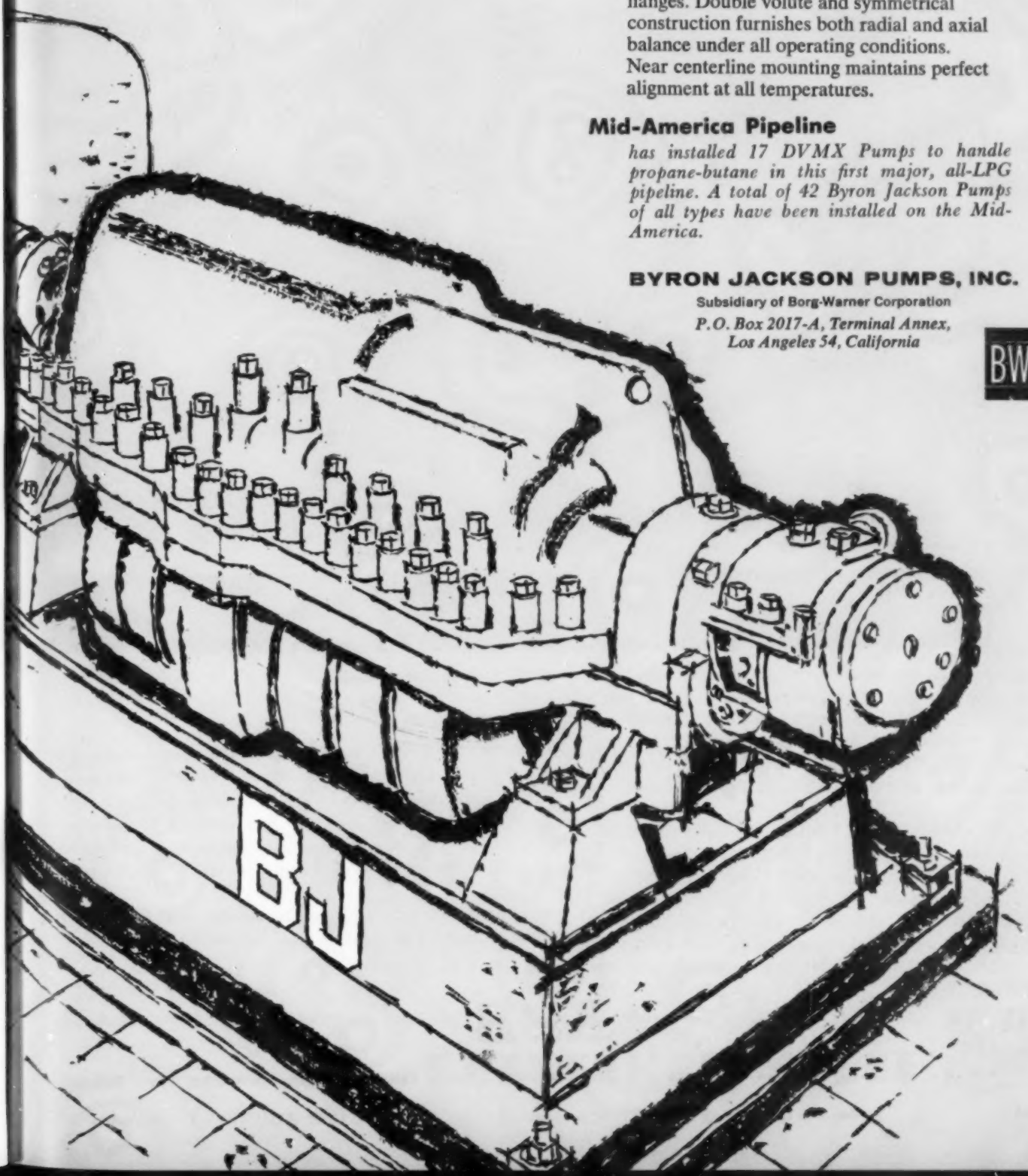

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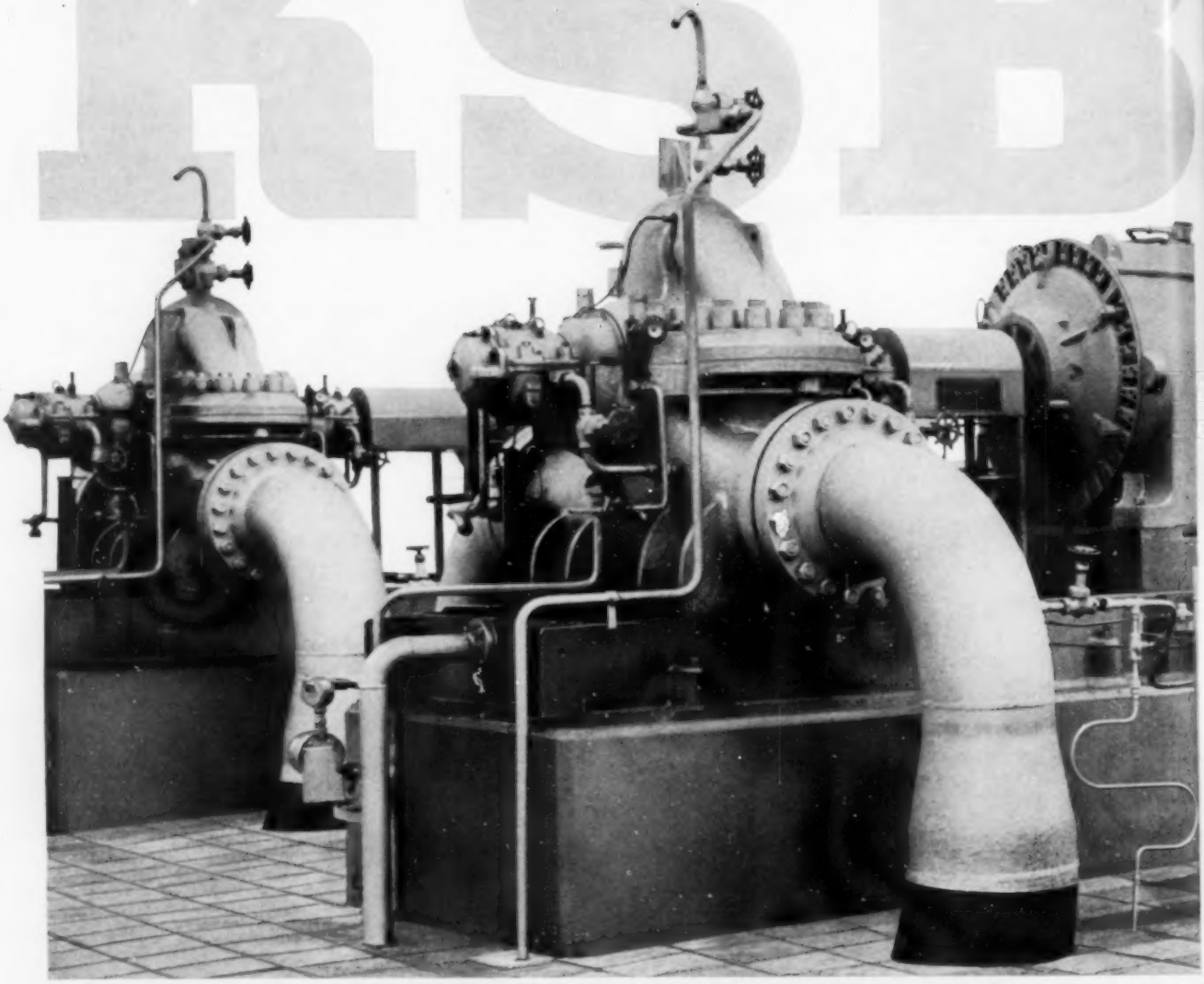

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KSB Pipeline Pumps designed on the basis of the latest experience with one or more stages to meet any of the usual operating conditions. The axially-split casing permits of the rotor being removed without disturbing the piping, which is connected to the lower half. The mechanical seal can be withdrawn withhout having to open the pump, since distance pieces in the coupling permit of axial movement of the shaft-seal elements towards the prime mover.

The sturdy construction and high-class workmanship of these pumps enable them to meet the most exacting service conditions.

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Trunkline waltzes through Vienna

The firing line welds multiple pipe joints for one of many road crossings.

That's Vienna, Illinois, a key point on Trunkline Gas Company's main line bringing natural gas from Texas and Louisiana to midwestern customers.

The snaking operation you see here took place in late spring of 1961, as Trunkline sped ahead with the construction of 154 miles of 30-in. x .361-in. main-line loops. Pipe for this 21-mile spread, extended north from Vienna, was supplied by Bethlehem Steel, and laid by Western Pipe Lines, Inc. We also furnished the pipe for Trunkline's 20-mile loop north of Oak Grove, Louisiana, where Panama-Williams, Inc., was contractor.

These days you can find Bethlehem High-Test Line Pipe on more spreads than ever before. That's because we recently expanded our output to meet the increasing demand for top-quality line pipe in diameters clear up to 42 in.!

Bethlehem Steel offers a full line of line pipe: From Sparrows Point, Md.—continuous buttweld from ½ through 4 in., nom., and electric resistance-weld from 5 2/16 through 16 in., OD. From Steelton, Pa.—electric fusion-weld from 18 through 42 in. OD. All Bethlehem line pipe meets appropriate API standards.

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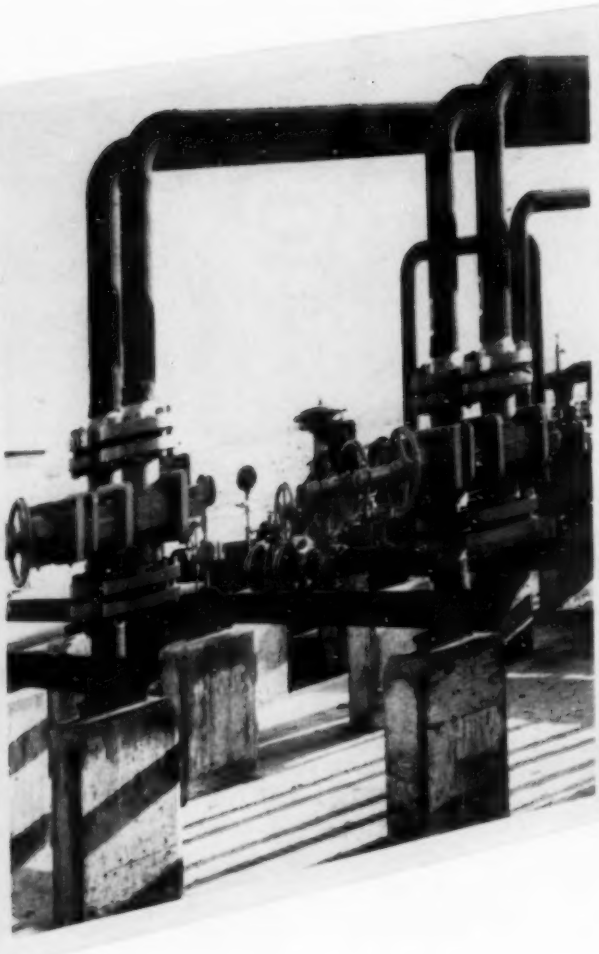

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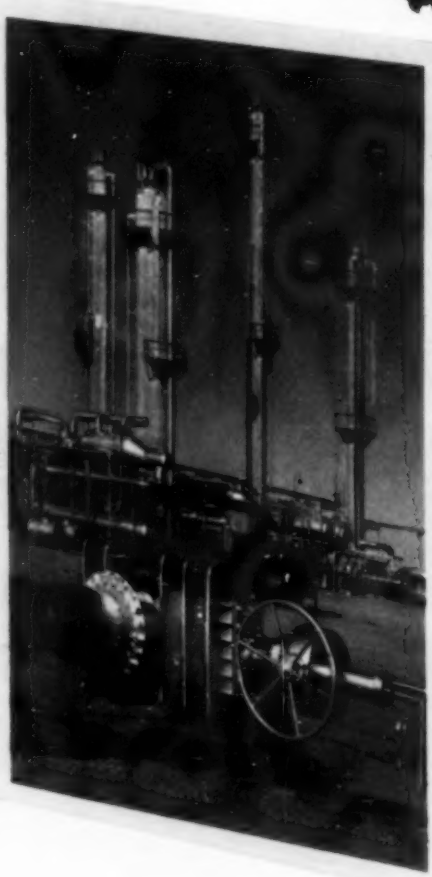

*We'll be glad to send you a copy!

The worth of a valve can often be measured by the companies it serves. And Grove Series G-4 pipeline valves have been performance-proved by hundreds of profit-minded transmission, distribution, crude and product pipeline companies! All over the world, the patented Seal-"O"-Ring design of Grove G-4 valves has been delivering dependable, positive, bubble-tight closing—without the expense and nuisance of periodic lubrication or adding of sealing compounds! Look around for the valves with the "hoop ribs." You'll be impressed with the broad acceptance of Grove Series G-4 gate valves in gas, crude and product service.

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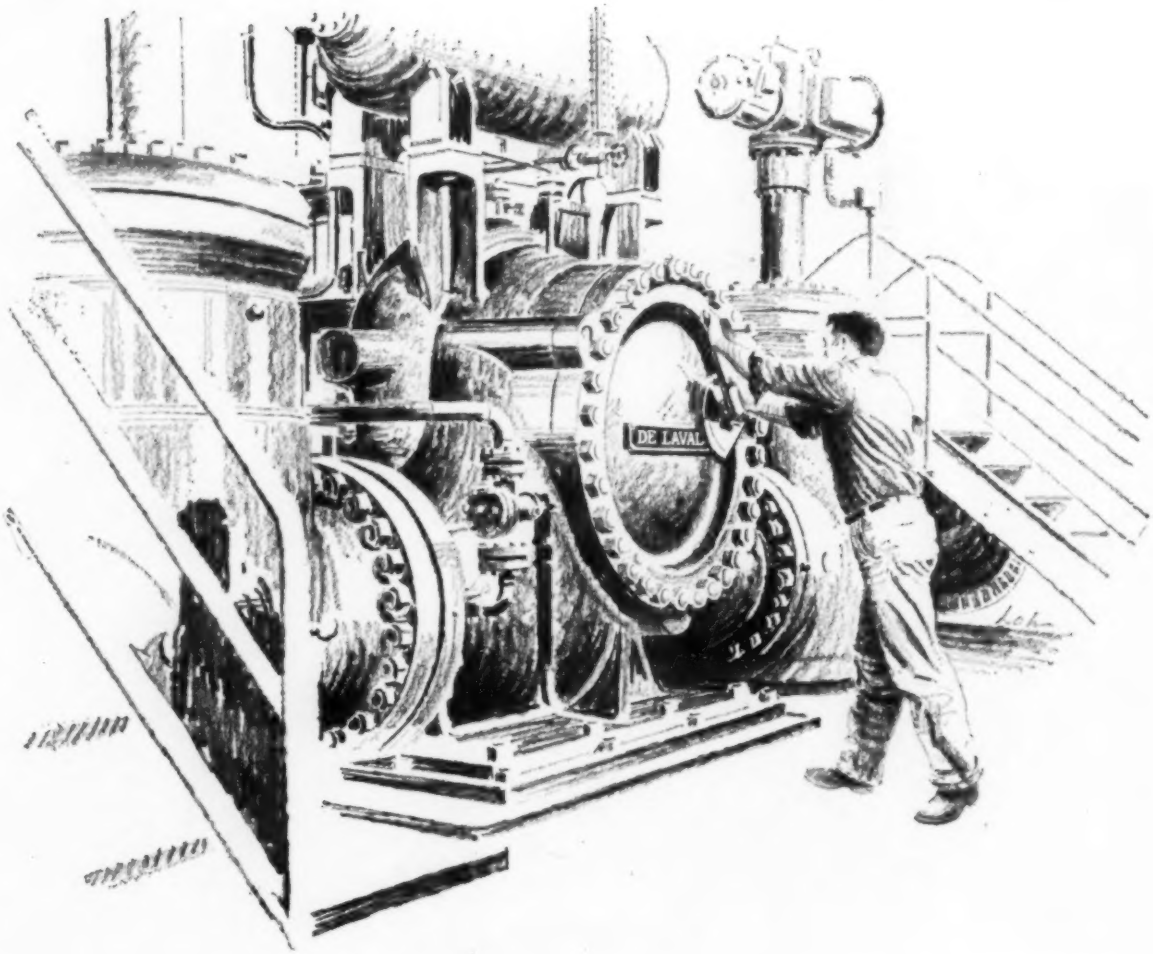
De Laval centrifugal compressors that boost gas through pipelines are a good example of De Laval engineered flexibility. Just two changes in parts — impellers and diffusers — increase compressor capacities and pressure ratios. Fluid flow keeps in economical step with growing demand.

Many companies face problems caused by fluctuating production levels, variable or interrupted operations, steady or rapid growth. To help solve such problems, De Laval engineers maximum flexibility into all of the many products it furnishes to industry.
De Laval Steam Turbine Co., Trenton 2, New Jersey.



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PIPE LINE PANORAMA

International Construction Boom Is Underway . . . More than 5,000 miles of crude, products and gas lines are on drawing boards, or are underway outside the United States in Eastern and Western Hemispheres—some may have powerful economic and political impact on areas they serve.

In Eastern Hemisphere, Russia's 2,500-mile line to carry **Second Baku** crude to **East Europe and Baltic Sea ports** is well along toward '63 target date . . . Construction of West Europe's biggest crude line, Societe du Pipe Line Sud-European's 450-mile, 34 incher from **Lavera, France to Karlsruhe, Germany** is underway . . . In Libya, Esso Standard has just completed 100-mile, 30-inch crude line from **Zelten field to Gulf of Sirte** . . . Austria is making economic study of proposed 320-mile crude line from **Trieste to Vienna,** which would terminate only 40 miles from one of Russian line terminals in Czechoslovakia, and within construction distance of line being built from **Karlsruhe to Ingolstadt in West Germany** . . . Burmah Oil is building 720-mile, 14 and 16-inch line in **India** . . . and ENI has started work on 600-mile, 18-inch line from **Genoa, Italy to Switzerland,** with an extension to Germany.

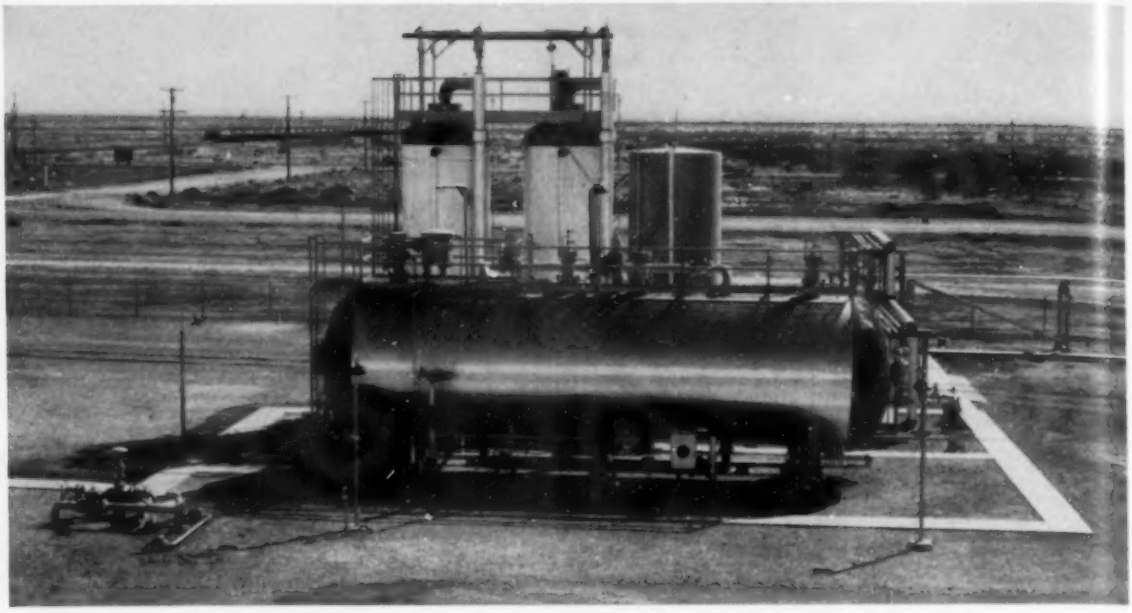
In Western Hemisphere, more than 7,000 miles of construction is now being completed in **U.S., Canada and Mexico** . . . Italy's ENI apparently has outbid U.S. firms for contract to build $240 million, 30-inch gas line 1,050 miles from **Comodoro Rivadavia in southern Patagonia, to Buenos Aires.**

The first complete report to be published on international pipe lines will be featured in December Pipe Line Industry:

Federal Rulings Rival Pipe Line Construction Pace . . . Kennedy-manned Federal Power Commission is feeling its oats, making several precedent-shattering decisions in recent weeks. Not to be outdone, Interstate Commerce Commision has added its two-cents' worth. Boxscore:

"Drip gas" is now "crude oil". ICC has ruled in split decision that condensate resulting from passage of natural gas through pipe lines will henceforth be considered as crude oil for carrier purposes. This byproduct is being transformed into other byproducts at rate of several thousand barrels daily, compared with 7 million barrels daily domestic crude production rate. Will pipe line condensate proration be next? **Interstate pipe line gas used intrastate is now subject to control.** Switching previous policy, FPC has ruled, in effect, that gas sales to interstate pipe lines will be federally controlled, even if contract says gas is to be used in State where it is produced or as fuel for engines or plant's operated by pipeline in other states. Reason: With Larry O'Connor dissenting, remaining four Commissioners say it is impossible to distinguish between inter and intrastate gas in a commingled stream. **New ruling on temporary construction permits.** In another policy reversal, FPC announces it will no longer grant temporary authority to build interstate natural gas lines until applications have been issued and hearings held. Only exceptions will be emergencies or on minor construction jobs.

Contracts may be rejected if they include indefinite price escalation clauses. Interested parties have until November 13 to express views on proposed FPC rules amendment that will provide for rejection of any independent producer natural gas sales contracts that contain indefinite price escalation clauses, also applications by natural gas companies relying upon such contracts for supply.



ELECTROSTATIC PRECIPITATOR is in the foreground. The tank contains five electrodes; unit is capable of separating water which contains FeS from some 68,000 barrels of natural gas liquids per day.

MODERN DESIGN AND AUTOMATION

Electrostatic Precipitator Removes Corrosion Products From NGL Lines

To keep dehydrators from fouling, Phillips adds fresh water to the natural gas stream, then coalesces the water with the precipitator . This removes particles, of FeS ranging from one half to 10 microns in size

By Leonard E. Lee,
Senior Operations Engineer,
Crude Oil Pipe Line Division of
Phillips Pipe Line Company,
Bartlesville, Okla.

PHILLIPS PIPE LINE COMPANY is using an electrostatic precipitator to remove corrosion products from a stream of natural gas liquids (NGL) to prevent fouling of dehydrators which are being used to minimize internal corrosion in a 10-inch pipe line.

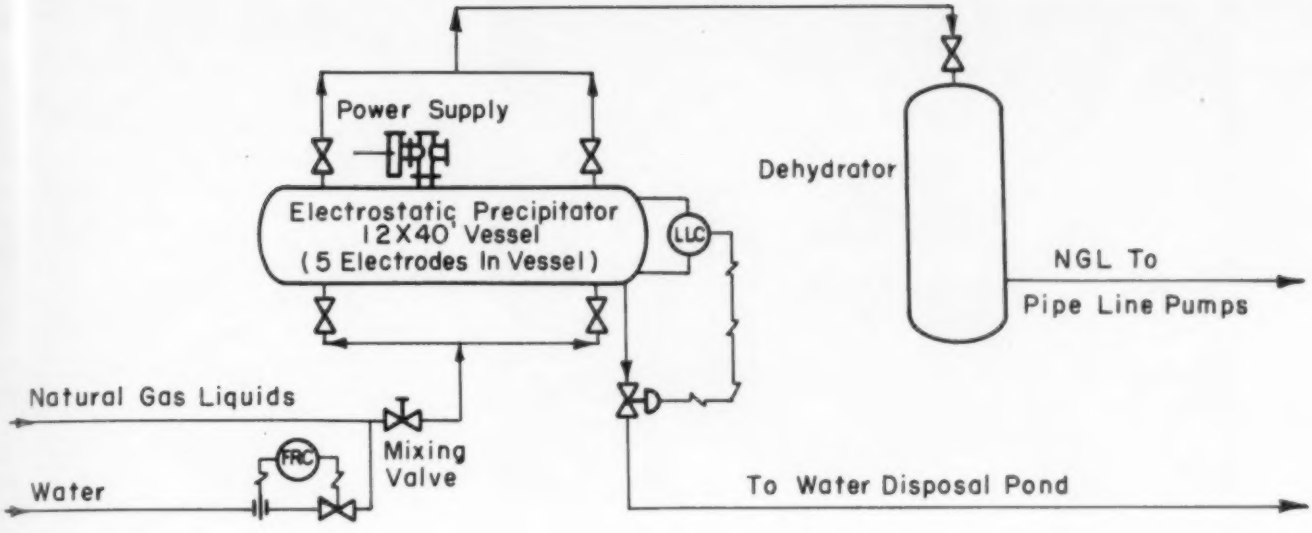
Background. This equipment (see illustration) is located at the Phillips' Benedum Terminal in West Texas. Each day the terminal receives about 60,000 barrels of NGL gathered by Phillips Petroleum Company through almost 600 miles of 2 to 8-inch lines which connect some 35 West Texas gasoline plants. This NGL is tendered to Phillips Pipe Line for shipment to the Gulf Coast via its 434-mile 10-inch line.

As it comes into the Benedum Terminal, the natural gas liquid has a specific gravity ranging from 0.570 to 0.600 and a Reid vapor pressure of 80 to 120, it contains corrosive materials including free sulfur, hydrogen sulfide, carbon dioxide, mercaptans and other sulfur compounds in solution and, at times, free water. It also contains iron sulfide (FeS) which is caused by the attack on metal of acidic compounds formed by hydrogen sulfide, carbon dioxide, oxygen and water. The particle size of the FeS is small—running from ½ to 10 microns with a preponderance of 1 to 2 microns.

From the first, engineers decided that the most economical means of protecting the 10-inch line from internal corrosion would be to dehydrate the stream. For without water, the attack of H_2S, CO_2, etc. is virtually eliminated. However, the presence of the FeS in the stream made this difficult. It was present in quantities ranging from zero to several hundred parts per million—more than enough to foul the dessicant in a dehydrator.

Why Not Filter? The most obvious solution to this problem would be to filter out the FeS. But filtering particles in the 1 to 2 micron size from a 60,000 to 68,000 barrels per day stream of natural gas liquids posed a difficult problem. In this case, engineers discarded the possibilities of filtering and decided to try water washing; an electrostatic precipitator was used then to remove the water.

Description of Electrostatic Precipitation. The electrostatic precipitator works on the principle that when an electrically conductive liquid



Flow sheet for electrostatic knock-out of FeS from LPG stream. Water is well mixed with incoming stream of natural gas liquids; mixture enters precipitator where charge coalesces the conductive water droplets and NGL and water phase separates into two layers. Water takes out particles of FeS ranging from one half to 10 microns in size.

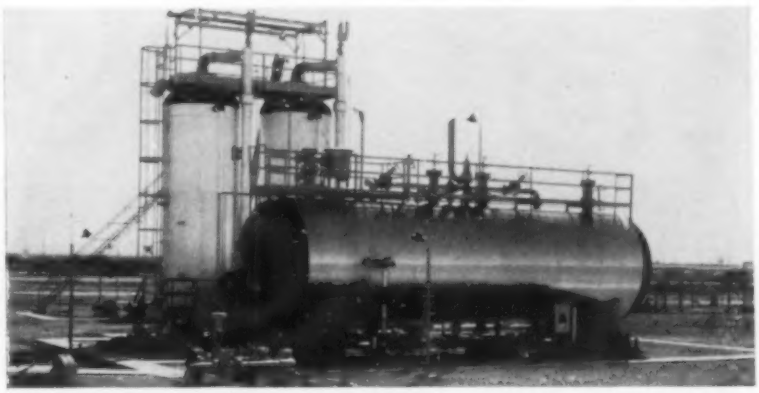
is dispersed into a non-conductive liquid, the separation into two phases can be accomplished rapidly and completely by passing the mixture through a high voltage direct current electrostatic field.

In this application, the conductive liquid is water, which is widely dispersed as small droplets in the hydrocarbon. Droplet size and dispersion is a function of the mixing energy imposed in the mixing valve.

Upon entering the electrostatic field, the small dispersed particles take on an electrical charge which in turn produces a random motion of the particles dependent upon the size of the particle and strength of the electrostatic field. The imparted motion greatly increases particle collision and results in the coalescence of many small particles to form drops of sufficient mass to readily settle by gravity to the lower portion of the vessel.

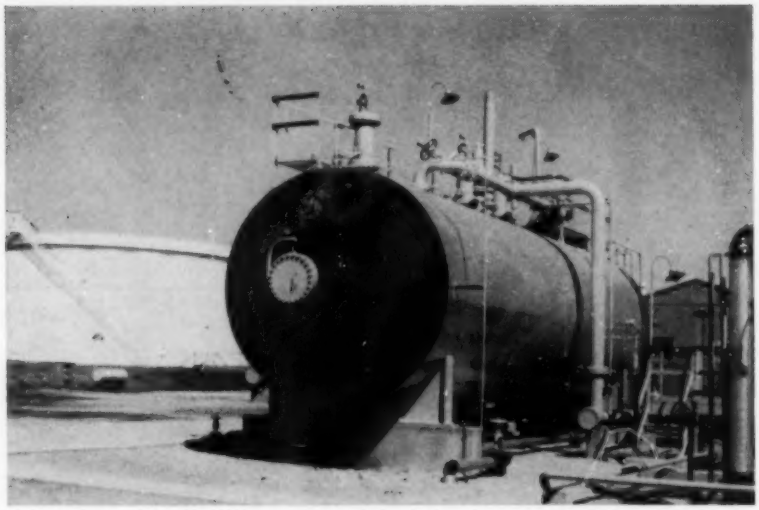
Description of Process Flow. The basic flow pattern is as follows: Natural gasoline liquid is mixed with one to three percent by volume of water, and the mixture is separated in an electrostatic coalescer (See flow diagram).

More specifically, water is injected into the natural gasoline feed line. The gasoline and water are passed through a globe valve to insure

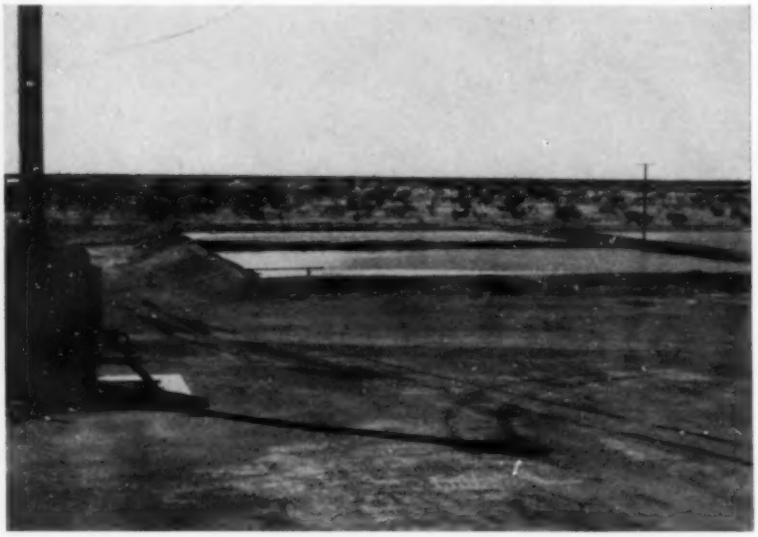


PURPOSE OF THE ELECTROSTATIC PRECIPITATOR is to remove the FeS which would otherwise foul the desiccant beds in the dehydrator units behind the coalescing vessel.

CONTROL PANEL. The electrostatic precipitator works on the principle that when an electrically conductive liquid is dispersed into a non-conductive liquid as small droplets, the separation into two phases can be accomplished by passing the mixture through a high voltage direct current electrostatic field.



WATER IS ADDED TO THE INCOMING STREAM through a mixing valve. The water picks up the FeS and when it coalesces it falls to the bottom of the vessel.



WATER CONTAINING THE FeS IS PUMPED TO THIS PIT where it will evaporate and soak into the ground.

thorough mixing which causes iron sulfide particles in the gasoline to be wetted. The pressure drop across the valve is an indication of the degree of mixing.

The gasoline, containing the finely dispersed water, is then fed into the bottom of the coalescing vessel. The inlet distribution header system is located about 18 inches above the vessel bottom. This point is also above the gasoline-water interface.

The coalescing vessel contains five fixed electrodes, of which the second and fourth are connected to the high voltage power supply. The other three electrodes are grounded to the walls of the vessel.

The gasoline-water mixture flows upward through the electrostatic field. The boundaries of this field are that space between the live electrodes and the ground electrodes, as well as between the live electrodes and the vessel walls. The electrically conductive water coalesces in this field. Consequently, the water phase containing the iron sulfide settles to the bottom of the vessel, while the gasoline phase continues on through the field and passes out the top.

The intensity of the electrostatic field is controlled between 20,000 to 25,000 volts. The coalescing effect can be optimized by adjusting the field intensity.

A constant level of the water phase is maintained in the lower part of the vessel through the use of an interface level controller. The level controller regulates the flow of effluent water from the coalescer.

Operating Results. The operation of the electrostatic precipitator and the dehydrators have attained the desired results, and with a minimum of operating problems. The precipitator hasn't required any modification nor maintenance, other than routine, for the 10 months it has been in service.

The water drained from the electrostatic preciptator varies widely in FeS content—for short test periods, it has even been black in color. The operation of the dehydrators indicate that there has been no fouling of the desiccant by a carry-over of the FeS. The precipitator has also eliminated the problem of slugs of water from the gathering system being pushed on through our trunk line. The protection of the main line pump units from FeS has placed our pump maintenance on a scheduled program and reduced the trouble calls to an occasional mechanical seal failure.

The "C" factors for the trunk line have held steady at a high level and allowed expenses to be cut by discontinuing two expensive programs—running sets of scrapers every two weeks, and injecting a chemical corrosion inhibitor into the stream. This, of course, has not only reduced maintenance costs but has increased the pumping capacity of the line.

About the Author

Leonard E. Lee, was graduated from the University of New Mexico in 1953 with a B.S. in civil engineering; in 1957 he received a B.B.A. in business administration. Immediately following graduation in 1953 he joined Phillips Petroleum Company's natural gasoline department.

In 1956, Lee joined Phillips Pipe Line Co. as a division engineer and was advanced to senior operations engineer in 1958.

ACKNOWLEDGMENT

The application of a water wash and electrostatic precipitation to remove solids is frequently used in the desalting of crudes. Credit for its use in this problem and its evaluation should be given to the development branch of Phillips Petroleum Co., Engineering Department and to manufacturers, Howe-Baker Engineers, Inc. and Petreco, Inc.

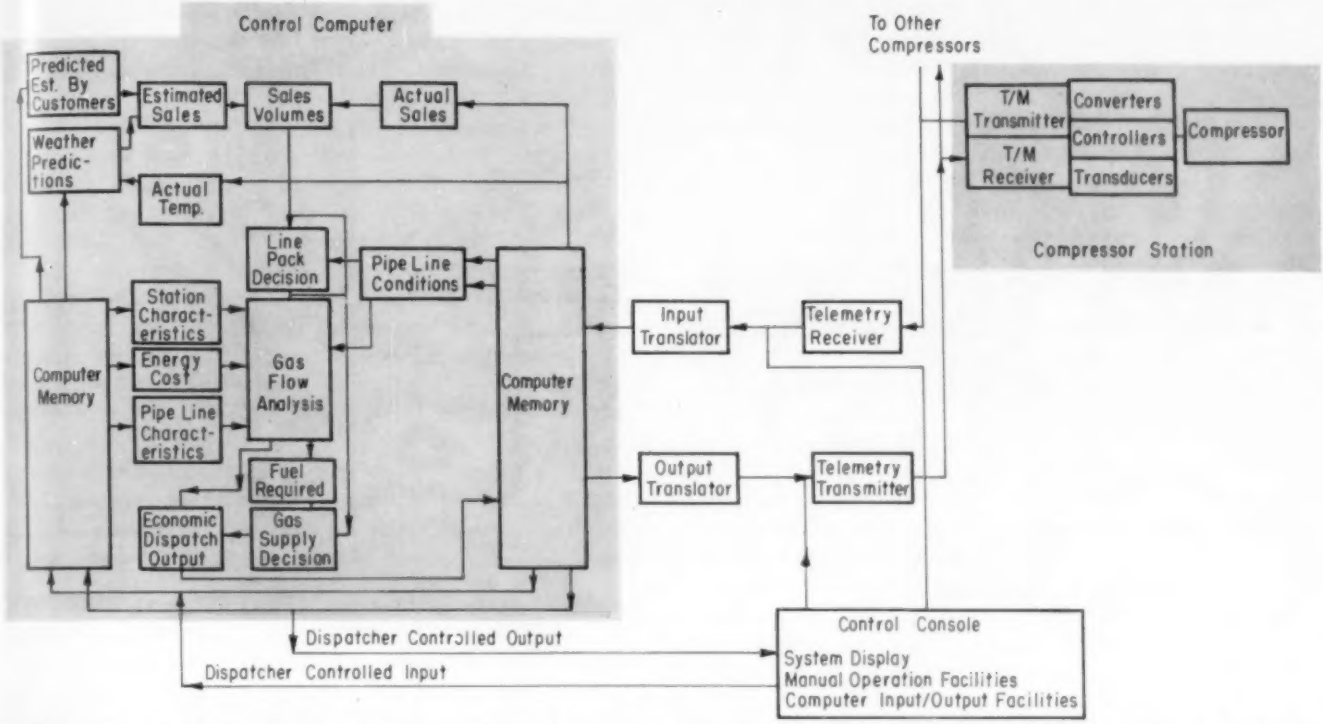


FIGURE 1—Over-all system block diagram. Note the many functions carried out by the dispatcher's control computer, which include: (1) Gas flow analysis, (2) Compressor set point analysis, (3) Sales analysis (4) Economic dispatch, (5) Gas supply decisions and (6) Data logging.

Modern Design and Automation

Outline for Automatic Compressor Station Design

By A. C. Winter,
Control Corporation, Minneapolis, Minn.

Here is a logical approach to the engineering problems involved in designing controls for reciprocating compressor stations

HERE IS AN OUTLINE which approximates the logic involved in the actual design of an automatic control system for reciprocating compressors. While, each pipe line is individual, this same approach to other systems can be followed with modifications.

FUNCTION IN THE SYSTEM

The compressor station acts as the controller on the controlled variable, discharge pressure, receiving a feed-signal from the central dispatch station in the form of a set point setting. It is the function of local control equipment to maintain the set point in the most economical manner to provide the central control center with sufficient data to dispatch the entire pipe line.

DATA COLLECTION

Assume that an unattended station is involved. Therefore, sufficient information must be made available at some central point to dispatch the pipe line whether it be a main or feeder line.

Variables Measured. For purposes of gas flow analysis, the following must be transmitted to the dispatch station: suction pressure, discharge pressure, suction temperature, discharge temperature, and number of units available.

In a computer control system, all gas flows, including fuel consumption, must be telemetered to the central station.

These variables will provide information to determine super compressibility, mean flowing temperature, throughput, and line pack. Other variables, such as ground temperature, specific gravity, pipe line efficiency, and specific heat are assumed as being known with sufficient accuracy.

Telemetry Characteristics. Manufacturers of telemetry equipment are currently placing greater emphasis on development of a reliable digital telemetering system using solid state components. This results in high speed systems which are capable of handling large quantities of data, such as is necessary in system control.

An advantage of digital telemetering is that it simplifies data logging. Figures 2 and 3 shown in block diagram form the components of two digital telemetering systems. No provision is made in either of these systems for data storage at the sending point, except for integrated flow which is normally a counter device. Should the telemetering system be comparatively slow, information storage facilities are necessary for concurrent logging. If the data

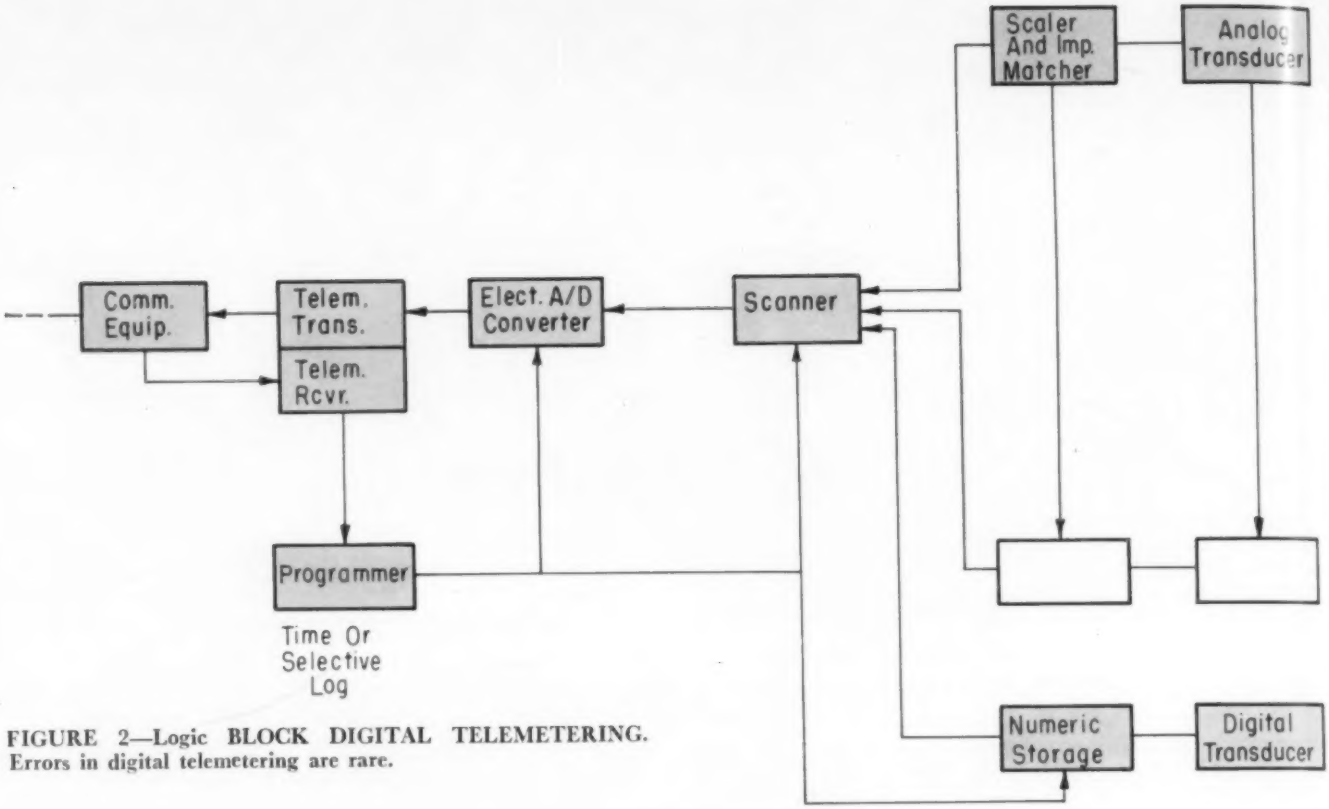


FIGURE 2—Logic BLOCK DIGITAL TELEMETERING. Errors in digital telemetering are rare.

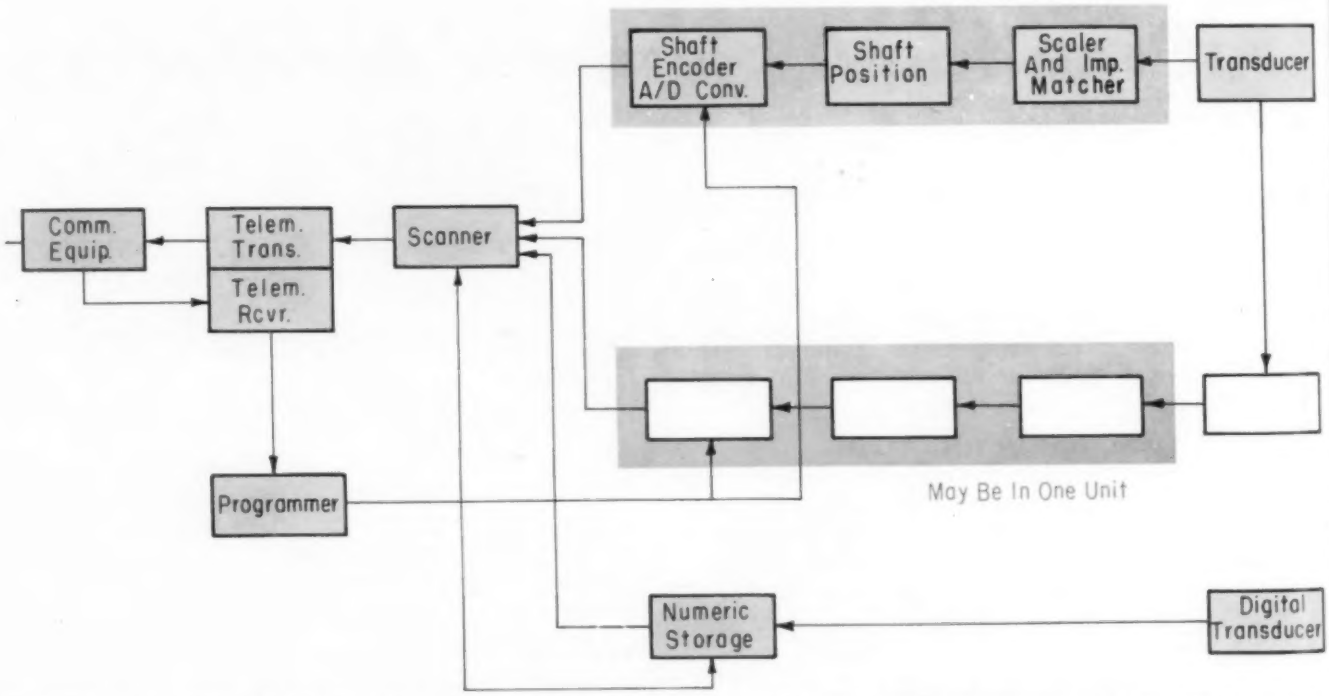


FIGURE 3—A SECOND LOGIC BLOCK DIGITAL TELEMETERING SYSTEM. Neither of these two systems (including Fig. 2) has provision for data storage at the sending point, except for integrated flow which is normally a counter device.

gathering system has the sole purpose of data logging, the number of output elements; that is, tape readers, typewriters, and readouts, depends upon telemetering speed, number of points monitored, and the acceptable time interval for receiving the complete log.

In the case of computer analysis of the pipe line system, design of computer input-output equipment depends upon the telemeter system. For items such as integrated flow, storage provision must be made at the metering station since a failure of the communications circuit results in a loss of information. To determine adequacy of the data collection system, consider its characteristics for (a) periodic logging, (b) alarm logging, (c) readout, indication, recording, and (d) computer compatibility.

Various types of data logging systems are available, but most of them have been designed with the prime purpose of local information logging. For the pipe line system, a logical design for minimum ultimate cost is to (a) have

facilities for data storage of certain variables at the compressor or metering station if information is not to be lost through communication failure, (b) have a high speed telemetering system that will allow the dispatch end to scan, at its discretion, those parameters necessary for flow analysis in a time which allows satisfactory solution of the flow problem, (c) have a system to which additions can easily be made, and (d) be reliable, which implies a minimum of mechanical or moving parts.

Accuracies of 0.25 to 0.50 percent are typical for temperature and pressure transducers. Because flow computers must take into consideration super-compressibility, pressure, and other variables for throughput correction to a common base, an error of approximately one percent can be expected in flow computers available on the market.

Because digital telemetering is the transmission of numeric information, generally no error is incurred in transmission. Validity checks are usually designed to disregard an entire transmission in the event of malfunction.

Cost Consideration. Digital telemetering costs are often greater than most users are accustomed to. Again, over-all systems planning is a necessity to keep costs to a minimum. In comparing investment costs, one data collection system may have a considerably higher initial cost, but a lower cost per point for additions. In the two types of digital telemetering systems shown in Figures 2 and 3, one uses a static A/D converter which is usually a component of higher cost than the electro-mechanical A/D. The number of points metered determines the breakeven point. Most mechanical converters must be stopped for scanning with a resultant time penalty. Compatability with other equipment may not allow a cost comparison.

Even though there is the trend toward high speed solid state telemetering systems, in some cases the lower investment cost of the slower mechanical contact, usually stepping switch type of digital telemetering system, can be justified. This may be the case where the number of variables telemetered is small.

STATION CONTROL EQUIPMENT

The gas pipe line in its entirety is a complex system, not necessarily because of the complexity of any one area of operation, but because of the number of elements involved. As a result, systems engineering becomes more important. Equipment suppliers acutely feel the need for systems engineering because more often than not, the time allowed by equipment users for quotations and delivery is insufficient to do the best job from the functional or economic viewpoint. Whereas, the subsequent dissertation will contain what may be described common knowledge, it summarizes the current trend in station control.

Functional Description. In the system described, station control is accomplished in three ways: (a) remote set point, (b) local set point, and (c) manual local set point, which provides for local operation without the use of, or interference from, the central dispatch equipment. Manual operation allows station operation without the use of closed loop controllers and much of the instrumentation. Figure 4 shows the following under command of the automatic instrumentation: Speed, pressure and/or flow, unit start-stop, station start-stop, and unloader pocket.

Pushbutton sequencing for start-up and shut-down follows the same pattern as in an attended station. The local annunciator displays the specific alarm; however, to minimize the number of alarm points that require transmission, and to avoid confusion caused by a large number of lights and meters at the dispatching station, alarm conditions are classified into several types. As an example: (a) first order faults shut-down, lockout and blowdown the station, thus requiring a local start, (b) second order faults shutdown and lockout, (c) third order faults shutdown, but allow remote or supervisory start, and (d) fourth order alarms give an indication only.

Equipment Layout. The functional block diagram of Figure 4 somewhat specifies the physical equipment layout. Local and remote set point operation is accomplished in parallel with manual control. Usually an explosion-proof local control cabinet is installed in, or next to, the compressor room. The trend is more and more toward electric equipment with the result that a control room is usually constructed at some distance from the compressor building in a non-hazardous area.

Whether or not all equipment is purchased from one manufacturer, for purposes of expediting manufacture and maintenance, equipment cabinets in the control room should contain a logical division of gear. As an example:

a. Unit controls and monitoring equipment . . 1 cabinet
b. Station auxiliary control equipment and annunciator . . . . . 1 cabinet
c. Station controllers and recorders . . . . . 1 cabinet

The station under remote control will, in general, require all the equipment normally used for local pushbutton controls since initially the system will be manned.

Equipment Characteristics. Figure 4 shows also the instrumentation system necessary for discharge pressure set point control. Protective, indicating, and control devices for the lube oil, blowdown, and other station auxiliary systems are not shown. Equipment indicated consists for the most part of off-the-shelf industrial components.

Reliability can be greatly improved by a thorough system study.

Controllers can, of course, be pneumatic or electric. Where the explosion-proof requirement is not necessary, most current thinking is toward electronic and electromechanical components. Electric component reliability is increasing and there is greater versatility for system design.

Speed Control. Assuming that the transmitted set point is discharge pressure, closed loop control is accomplished as follows:

Actual discharge pressure is measured, using a transducer with an electrical output proportional to pressure; that is, the feedback signal.

Set point is received by the digital telemeter receiver and stored in a memory circuit. This may consist of a relay matrix having connected to it, precision resistors which, when regulated voltage is placed across them, gives a voltage proportional to the transmitted discharge pressure.

An error detection circuit in the controller measures the difference between actual pressure and set point perssure. This proportional signal produces an electrical output which operates the governor in such a manner as to correct for the pressure differential. In adddition to proportional control action, reset type control is used to

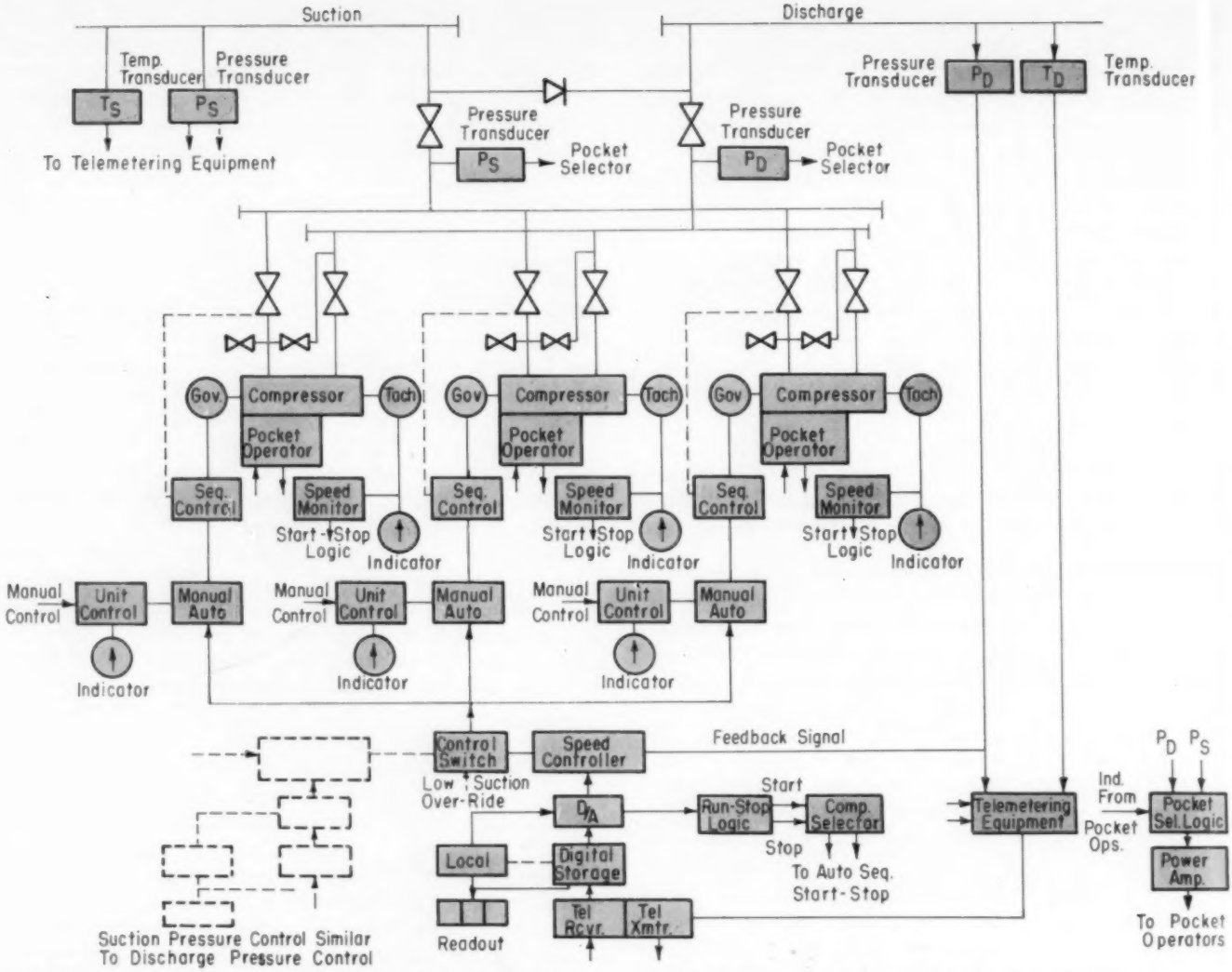


FIGURE 4—INSTRUMENTATION LOGIC FOR PRESSURE CONTROL. In this case, local and remote set-point operation is accomplished in parallel with manual control.

prevent overshoot and to compensate for the delay time in attaining a pressure change by varying compressor speed.

Should control be desired on suction pressure or throughput when preset conditions occur, a second controller is automatically switched into the control loop.

With a greatly changing throughput, the big problem is discharge set point determination taking into consideration gas transport time delay. It is feasible to use steady state gas flow equations for pressure determination if data is updated frequently, and use is made of a computer for problem solution. Since a gas transmission system is in actuality never in a steady state condition, equations which express pressures and flow as a function of time are more accurate, requiring a computer for solution of differential equations.

The tendency is toward the use of electric components, not necessarily because of reliability, but because of versatility at lower cost. Making electric components explosion-proof is costly; however, in most cases a non-hazardous area exists.

Start-Stop Control. To start another compressor, certain conditions must exist. For instance, a present deviation from set point, existing for a specified period of time, with units currently on-line running at some predetermined speed, can be the criteria for starting. Electrically, speed and deviation from set point can be voltage levels detected by sensing circuits, contacts on servo shafts, or other devices.

An adjustable timing device can be used to avoid unnecessary starting even though the pressure and speed criteria are met, should throughput considerations warrant a delay in starting.

On an unattended station, elapsed time meters can be used to keep running time on all units. A switch wired to change the starting sequence, manually operated from time to time, is an inexpensive way to equalize running time. Otherwise a scanning circuit can be used to scan the elapsed time meter and determine automatically which compressor has the least elapsed running time.

A more thorough investigation is required for stopping logic since it is possible for all units at a minimum loading condition to carry a smaller load than fewer units loaded, resulting in excessive fuel consumption. It can be considered fortunate that the fuel cost versus horsepower output characteristic of the reciprocating engine is quite flat from 80 to 100 percent full load. Assuming that the range of throughput characteristics are known, the number of engines running and speed can be used as logic for stopping.

Pocket Control. More consideration is being given to automatic individual pocket control as a means for maintaining desired pressure or throughput; remote or super-

visory control of pockets by a dispatcher is one method in use.

With a predictable throughput and, in particular, a comparatively constant one, pockets can be operated in groups using discrete throughput, pressure, or speed limits for operating criteria. This philosophy requires a thorough investigation of throughput vs station capacity.

With the advent of large, swinging loads, and to avoid excessive torque conditions, individual pocket control can, in some cases, be beneficial. One method to accomplish this is through the use of an analog computer-controller. A detriment to this idea is the cost involved. Using a 4-cylinder compressor with head end and crank end pockets, allows nine settings as shown in Figure 5.

Curves shown define suction and discharge pressure at which a pocket must be operated to avoid excessive torque on the unit. The compressor can, of course, be operated unloaded to a greater extent; however, fuel consumption per BHR-HR rises as percent of full load decreases.

Logic incorporated in the controller-computer operates the compressor as near the 100 percent torque condition as possible for any pressure conditions.

As suction and discharge pressure conditions change, due to a new set point or a variation in suction conditions, it is possible that the compressor characteristic curve dictated by the current pocket setting will be crossed (Figure 5). Pressure changes in one direction cause another pocket to open, and if in the other direction, a pocket will be closed.

In the operation described, speed is used to maintain discharge pressure (or throughput) until a pocket change is dictated by the pocket controller; whereupon, compressor capacity is changed with a consequent widening of the speed control range.

Initially, the compressor is unloaded and a timing device is incorporated in the pocket controller to close only one pocket at a time as the compressor comes on-line. For more than one compressor in parallel, the same controller-computer would operate all units at the same pocket setting.

Cost Considerations. When compared to the investment cost for the engine and compressor itself, the instrumentation costs for automatic control may seem proportionately high. In writing specifications, the first responsibility is having an adequate instrumentation and protective system; however, care is necessary to avoid more than adequate instrumentation.

Where a measured variable performs more than one function; such as control, telemetering, and indication, one instrument may serve. Usually in these cases, a certain amount of additional equipment is still necessary for signal isolation and impedance matching. Where only indications are required at the station for certain oil pressures and temperatures, etc., the use of a pressure gage or thermometer serves the purpose and the use of electric transducers for these items results in higher costs.

Instrumentation for some type of pocket control is practically a necessity; the question is, to what extent? Individual pocket control can, of course, be accomplished in a multitude of ways, and the manner would most likely be different for every equipment supplier. One type of controller for individual pocket control is priced in excess of ten thousand dollars; however, the fuel cost

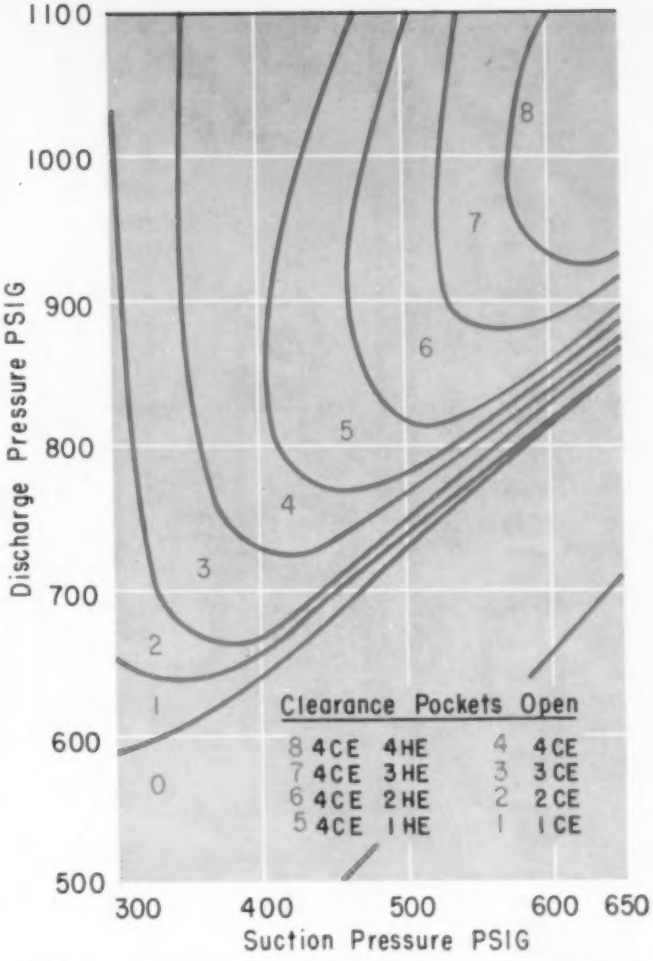


FIGURE 5—Nine clearance pocket settings for a four-cylinder compressor with head-end and crank-end pockets.

savings may ultimately pay for the added investment cost.

Since the fuel consumption per bhp-hr rises rapidly at small engine load, the greatest danger of excessive fuel consumption exists if the number of units on-line is not minimized.

Detailed systems engineering not only reduces the investment cost, but, more important, increases reliability.

ACKNOWLEDGMENT

From a paper presented before the American Society of Mechanical Engineers meeting in Kansas City, Mo., Sept. 24-27, 1961.

About the Author

A. C. Winter was graduated from the University of Minnesota in 1953 and joined Ebasco International in Brazil as a transmission and distribution engineer for electrical power systems. In 1956 he went to work for Electric Machinery Manufacturing Co. as an application engineer, developing specifications for large motors with variable speed drives, etc. In 1957 Winter became a project engineer with Control Corp. Since then he has designed supervisory control and telemetering systems for electric utilities and products pipe lines. He is active in study groups investigating computer-controlled gas pipe line systems.

Use This Check List for A.C.T. Installations

THE RECENT TREND toward automatic custody transfer has found many organizations without enough adequately trained personnel to handle the design, engineering, installation and initial operation. But this handicap can be greatly reduced through use of this checklist. One pipe line company has found it invaluable to the engineers who are saddled with the problems of inspecting, supervising installation, assisting in the preliminary calibration, making operating checks and arranging for final approval of equipment.

This checklist was developed by a pipe line company which did not participate in providing equipment or labor for the ACT facility. However, the company did insert its engineering standards both as to equipment and construction.

You may note that this checklist was specifically compiled for a master meter proving set up. It has been adapted for prover tank installations but is presented in this form because the master meter proving unit is becoming a popular type of operation. Also, pieces of equipment are included that may not be applicable even though they should be considered for each unit.

AUTOMATIC CUSTODY TRANSFER UNIT CHECK LIST

DESIGN	INSTALLATION	OPERATION	
			Preliminary
☐	☐	☐	Have necessary permits been obtained from state and federal authorities?
☐	☐	☐	Have tenders, contracts, facility designation, ticket forms and beginning date been arranged for liquid transfer?
☐	☐	☐	Have formal pipe line specifications and policy been presented to the Seller and Contractor?
☐	☐	☐	Have maintenance and proving policies been arranged?
☐	☐	☐	Have copies of complete plans, operating schematics and wiring diagram been arranged for?
☐	☐	☐	Have plans been approved by both the Seller and Pipeline?
☐	☐	☐	Is the Seller and his authorized representative familiar with proving procedures, meter factors, calculations and has the meter been entered on a proving schedule.
☐	☐	☐	Have proving and calibration certificates been provided for Seller?
			Positive Displacement Meter
☐	☐	☐	Is meter operating with maximum and minimum rates and pressure range limitations recommended by manufacturer?
☐	☐	☐	Is operating volume of meter within maximum and minimum limits projected by Seller and Pipeline?
☐	☐	☐	Is adjustment provided for calibrating volume of meter?
☐	☐	☐	Is adjustment provided for compensating for specific gravity of liquid measured (or drilled for weighted sample of liquid to be handled)?
☐	☐	☐	Is temperature compensator operating in recommended range?
			BS&W Monitor
☐	☐	☐	Does unit provide adjustment in calibration-variable within 3 percent BS&W?
☐	☐	☐	Is the probe located according to API specifications and upstream from meter and diverting valve?
☐	☐	☐	Can unit be easily calibrated?
☐	☐	☐	Is probe plastic coated and in a flanged connection section?
☐	☐	☐	Is unit located within prescribed distance from probes as indicated by manufacturer?
☐	☐	☐	Is adjustment set at specified percentage?
☐	☐	☐	Has monitor been "broken-in?"
			Controls
☐	☐	☐	Is meter under full protection at all times during operation (no "manual" switch)?
☐	☐	☐	Are interlocks provided between meter, sampler, BS&W monitor, charge pump, pipe line pump, lease equipment, etc.?
☐	☐	☐	Are temperature controls provided? (120° F Max.)
☐	☐	☐	Are all control switches positive in providing complete protection when liquid is being metered?
☐	☐	☐	Does meter provide a pulse transmitter for each barrel of "Gross @ 60° F" liquid measured?
☐	☐	☐	Are all controls pulsed from a common transmitter?
☐	☐	☐	Does automatic sequence provide for restart after power failure?
☐	☐	☐	Does automatic sequence provide for restarting on "good oil" signal?
☐	☐	☐	Is adjustable low flow-no flow provided on a pulse signal from the meter, providing lock out feature for delivery on meter pulse failure in open or close contact position of pulse transmitter.
☐	☐	☐	Is allowable control of daily-reset, monthly and program type?
☐	☐	☐	Are allowable controls within range requirement (significant figures)?
☐	☐	☐	Do allowable controls pulse on restoration of power?
☐	☐	☐	Does special keyed three-position proving switch provide the following:
			"Automatic"—Leave completely normal automatic function for period during key removal.
			"Read"—Override high float switch in tank; charge pump runs; bypasses BS&W Monitor, sampler control, low flow-no flow protective device; close back pressure-shut-in valve; shut down pipe line pump.
			"Prove"—Complete automatic operation with exception of overrides of high float switch in surge tank.
☐	☐	☐	Does control sequence provide for minimum surge in proving operation (charge pump remain in operation at all times during proving master meter)?
☐	☐	☐	Is 30 seconds time delay provided in monitors signaling "bad oil," and 30 seconds time delay provided in its resignaling "good oil"?
☐	☐	☐	Are lights provided to indicate function of control as being operative or non-operative (low flow-no flow, sampler, BS&W monitor, charge pump, pipe line pump, daily reset, monthly allowable, etc.)?
☐	☐	☐	Does control panel provide a sealable enclosure for entire switching and circuit system (excepting keyed proving switch)?
☐	☐	☐	Are ACT unit and pipe line operation compatible as to volumes and pressures?
☐	☐	☐	Is back-pressure shut-in valve provided?
☐	☐	☐	Is back-pressure valve operating on clean gas, air or liquid from sensing source

- ☐ ☐ ☐ Is operating volume of meter within maximum and minimum limits projected by Seller and Pipeline?
- ☐ ☐ ☐ Is adjustment provided for calibrating volume of meter?
- ☐ ☐ ☐ Is adjustment provided for compensating for specific gravity of liquid measured (or drilled for weighted sample of liquid to be handled)?
- ☐ ☐ ☐ Is temperature compensator operating in recommended range?
- ☐ ☐ ☐ Is temperature compensator accurate within 0.002 repeatability?
- ☐ ☐ ☐ Has arrangement been made for a traverse of temperature compensator?
- ☐ ☐ ☐ Can the meter be maintained internally without disturbing alignment of temperature compensator-calibrator-ambient bellows alignment?
- ☐ ☐ ☐ Are capillary tube and ambient bellows shielded and insulated against elements?
- ☐ ☐ ☐ Is sensing bulb located in center of flow immediately upstream from meter?
- ☐ ☐ ☐ Is sensing bulb located for easy inspection?
- ☐ ☐ ☐ For nonlubricating liquids—is external lubrication provided for bearings?
- ☐ ☐ ☐ Are internally lubricated bearings flooded with circulating liquid?
- ☐ ☐ ☐ Are the internal meter parts coated with corrosion resistant metal?
- ☐ ☐ ☐ Does meter have large numeral—reset counter for interpolation to 0.001 barrel on proving readings?
- ☐ ☐ ☐ Is a ticket printer provided that is compatible with standard meter tickets? (Six-figures including tenth of a barrel.)
- ☐ ☐ ☐ Does ticket printer provide a "sequence number" and meter "identifier?"
- ☐ ☐ ☐ Is a sealable, tamper-proof cover provided for the meter transmitter, counter-printer combination with window for viewing totalizer?
- ☐ ☐ ☐ Is meter piped so body will be free of mechanical strain?

Sample Equipment

- ☐ ☐ ☐ Is sampler volume compatible with meter pulse for adequate volume of sample (3-4 gal per metering period) and proportional to flow?
- ☐ ☐ ☐ Has a purge pump for sample container been provided?
- ☐ ☐ ☐ Is sample pump adjustable (timing or volume) to ±5 percent accuracy in volume sampled each extraction?
- ☐ ☐ ☐ Is sample pump positive in action for taking from vacuum and positive pressure source?
- ☐ ☐ ☐ Is sample probe designed and installed according to these API standards? Beveled, slots, holes, ell; bevel, slots, etc. facing up stream; sampling opening centered in pipe; probe 5 pipe diameters downstream from nearest obstruction.
- ☐ ☐ ☐ Are sample lines adequate in size (¼-inch maximum)?
- ☐ ☐ ☐ Are sample lines short to prevent unnecessary retention in lines? (5 inches max. for probe to pump line, and pump to container line.)
- ☐ ☐ ☐ Are sample lines downgraded from point of withdrawal to sample pump, and from sample pump to container?
- ☐ ☐ ☐ Are sample lines and sample container insulated against heat?
- ☐ ☐ ☐ Is sample inlet above middle of height of container?
- ☐ ☐ ☐ Is sample container plastic, or plastic coated internally?
- ☐ ☐ ☐ Is volume and pressure rating of sample container adequate (5 gal. min., 20 psi min.)?
- ☐ ☐ ☐ Is the container vapor diaphragm made of plastic?
- ☐ ☐ ☐ Can sample container be agitated thoroughly and easily?
- ☐ ☐ ☐ Are sampler adjustments, valves and container provided with seal devices?
- ☐ ☐ ☐ Is interlock provided to shut-in ACT unit on sampler failure?

- ☐ ☐ ☐ Does control panel provide a sealable enclosure for entire switching and circuit system (excepting keyed proving switch)?
- ☐ ☐ ☐ Are ACT unit and pipe line operation compatible as to volumes and pressures?
- ☐ ☐ ☐ Is back-pressure shut-in valve provided?
- ☐ ☐ ☐ Is back-pressure valve operating on clean gas, air or liquid from sensing source (foul safe)?
- ☐ ☐ ☐ Is back-pressure valve adjustable within accuracy demanded by charge pump characteristic?
- ☐ ☐ ☐ Is a pipe line strainer of adequate size provided in suction to ACT unit?
- ☐ ☐ ☐ Is a check valve provided in run?
- ☐ ☐ ☐ Is a centrifugal charge pump used and is it compatible with pipe line pump? (Operating point on curve allows adjustment in rate and head)?
- ☐ ☐ ☐ Is air eliminator provided of adequate size and design?
- ☐ ☐ ☐ Is vent equipment adequate for volume and is it fail safe?
- ☐ ☐ ☐ Is sump provided of adequate volume?
- ☐ ☐ ☐ Are sump controls interlocked with unit controls?
- ☐ ☐ ☐ Is lightning protection provided?
- ☐ ☐ ☐ Is the keyed prover switch connection located conveniently for large numeral counter observance, and for access to master meter counter?
- ☐ ☐ ☐ Is meter large numeral counter located and keyed high enough for being easily observed?
- ☐ ☐ ☐ Is "tell tale" provided in line between prover connection?
- ☐ ☐ ☐ Are prover connection valves provided with locking devices?
- ☐ ☐ ☐ Are prover connections of quick coupling type and size required?
- ☐ ☐ ☐ Is location of prover connections convenient for master meter trailer?
- ☐ ☐ ☐ Is meter run free from surge in liquid during operation?
- ☐ ☐ ☐ Are provisions made for diverting "bad oil" while ACT unit is shut-in?
- ☐ ☐ ☐ Is liquid being metered within vapor pressure limitations?
- ☐ ☐ ☐ Is oil being metered of grade contracted?
- ☐ ☐ ☐ Is location of ACT unit in a safe position with producing facilities and convenient for pipe line connection?
- ☐ ☐ ☐ Is equipment located for easy maintenance?
- ☐ ☐ ☐ Have provisions been made to break in meter with 2,000 bbls. of throughput to check and/or re-establish meter factor?
- ☐ ☐ ☐ Are ½ inch taps provided on meter outlet, meter inlet, charge pump suction, charge pump discharge, upstream from back pressure valve, downstream from back pressure valve, upstream from strainer, downstream from strainer, suction of pipe line pump, discharge of pipe line pump, etc.?
- ☐ ☐ ☐ Is one pressure gage provided within operating range 0-15 psi)?
- ☐ ☐ ☐ Is a thermometer well located near the meter inlet?
- ☐ ☐ ☐ Are there any bypasses for meter?
- ☐ ☐ ☐ Is meter run isolated from vibration source?
- ☐ ☐ ☐ Has unit been checked for sequence of operation and against plans prior to its leaving the fabricators plant?
- ☐ ☐ ☐ Has unit sequence in operation and completeness in installation been checked 24 hours prior to time of commencing automatic custody transfer?

This is not a cure-all for Automatic Custody Transfer, but so far it has proved to be highly effective in guiding engineers and technicians not fully versed with the finer points of ACT units. The list has enabled one company engineer to supervise three projects simultaneously. —**The End**

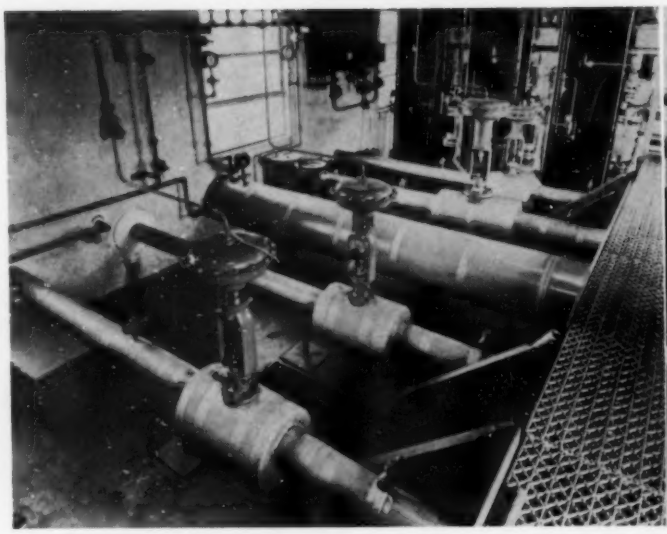


FIGURE 1—Regular piping is lagged with 2-inches of glass fiber and then a 0.055 inch thick septum of leaded vinyl. Noise level was reduced from 110-130 decibel level to 90-110 db.

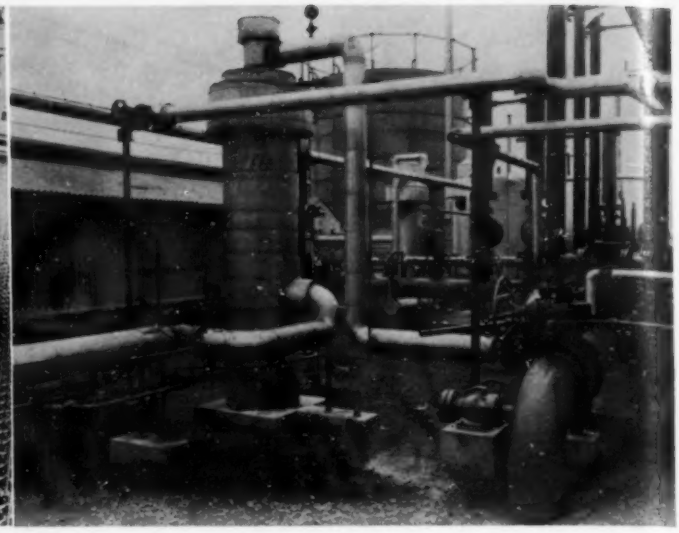


FIGURE 2—Noise reducing lagging of glass fiber and leaded vinyl was also applied to outside piping at Public Service's Trenton, N. J. station. Covering six 14-foot lengths of pipe, valves, and a by-pass took one man only six days.

Modern Design and Automation

Lead-Vinyl Insulating Covering Reduces Regulator Station Noise

Tests show a reduction of 30 decibels

ONE OF THE VEXATIONS that continue to plague engineers in the gas pipe line business is that a well-designed high capacity regulator station which is operating perfectly may turn out to be a public nuisance. Measurements of noise levels inside the pressure reduction buildings may run from 110 to 130 decibels. This is less noise than a four-engine jet makes (140-160 db.) but considerably more than a subway train rumble (90 to 100 db).

This sound is of sufficient intensity to make the gas company unpopular with near by residents and business firms.

Public Service Electric & Gas Company of Trenton, N. J., has found a solution which holds much promise. By coating the piping in the regulator stations with limp lead-loaded vinyl plastic material backed with cloth, the company has cut the noise level approximately 30 db so that it is now possible to talk inside the regulator building without shouting. Moreover, the low noise level has reduced the number of irate calls from the offended citizenry.

As shown in the drawing, the pipe is covered with a preformed lagging of very fine yarn glass wool about two inches thick. This, in turn, is covered by a leaded vinyl septum which is 0.55 inch thick and weighs 0.87 pound per square foot.

This single layer of leaded plastic is sealed in a self-adhesive fabric tape.

Labor requirements for this noise reduction program are reasonable. One man was able to cover six 14-foot lengths of pipe along with valves, bypasses etc. in six days. Public Service engineers say the results were well worth it. Noise was reduced greatly. Engineers are planning to use this teachnique at other stations where noise has been a nuisance.

Eight pipe line companies are installing this new material in pressure-reducing stations and at least one company is trying the leaded plastic in a compressor station to counter the noise level. —The End

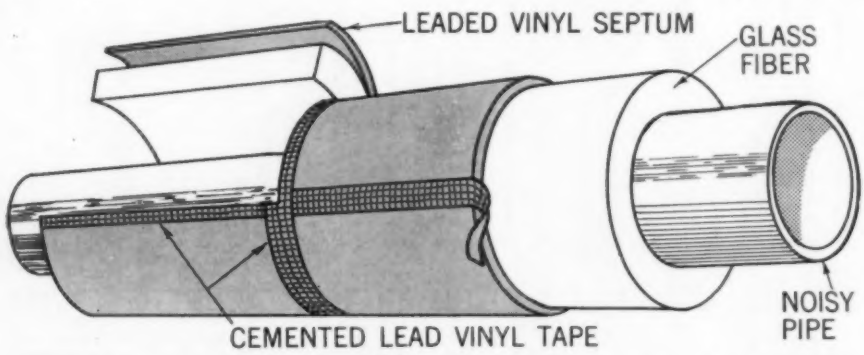


FIGURE 3—How leaded vinyl and glass fiber lagging are applied. Seams are sealed with an adhesive coated lead-vinyl tape.

Programing Pipe Line Operations for Optimum Power Conservation

By Paul Pancio, Jr., Programer Analyst
Gulf Oil Corporation, Houston

CALCULATIONS AIMED at developing operating practices which would minimize the power cost for moving crude products through a pipe line have in the past been based on numerous assumptions. But with the advent of the electronic computer, engineers have been able to replace most of these assumptions with facts. And this refinement has proved highly valuable for operators of a 26 and 20-inch line running from West Texas to the Gulf Coast.

The 26-inch leg of this crude oil system is 466 miles long; it is intersected by a 112-mile 20-inch line from East Texas near Corsicana. For the most part, the system is closed; tankage is provided only at the originating station and at the junction of the two lines.

The system which began operation in 1953 with three stations has been expanded to six stations having a total of more than 42,000 horsepower. All pumping units are electric motor driven centrifugals.

All movement of oil is west to east. The majority of tenders enter the system at the originating station, although some volumes are also injected at two booster stations. All deliveries are approximately at the two eastern ends of the system.

The size and operation of the system indicate that an orderly determination of pumps must be made if power costs are to be minimized. When the system began operation, a procedure was developed for calculating a Pumping Rate Table to serve as an operating manual. This listed the proper units to use at each station over the full flow range. Basically, the procedure used was this: A configuration of pumps was assumed at each station, and the capacity of these units was determined. At this flow the monthly cost was calculated at each station. This was repeated, starting with the single smallest unit at the originating station, up to the use of all units.

The above procedure, then, determined the cost at various points, these points being the capacity of each specific scheme of pumps. Next it was determined which combination of schemes could be made that by pumping at each scheme's rate for varying portions of a day, it would be possible to average any flow between, while maintaining minimum cost.

System expansion eventually invalidated the existing tables. The availability of an electronic computer offered a calculating speed that allowed computing those factors previously assumed.

VARIATIONS INVOLVED, MAJOR

The significant factors involved in the power optimization problem under discussion will be as follows:

1. Pumping Rate Table used to make the monthly determination of units to be used at each pump station will give two selections for every flow rate. By pumping at each of the two rates for prescribed times, the exact throughput will be delivered, and no throttling of pressure will occur.
2. Equations of the form $y = ax^3 + bx^2 + cx + d$ will be used to represent the head curve *(y)* or brake horsepower curve *(y)* of each pump. A prior curve fitting routine determines the coefficients *a*, *b*, *c*, and *d*. Flow rate is designated *x*.
3. A straight line $y = mx + b$ will be used to represent motor efficiency *(y)* over the range of normal load. Flow again is represented by *(x)*.
4. The following method will be used to calculate the maximum capacity of a given scheme of units: A straight line false positioning technique plotting unused pressure versus flow, solved for pressure equal to zero, will generally perform this. Exceptions are handled in the program by the solution of three simultaneous equations involving unused pressures and flow rates to determine the coefficients of an equation of the form $ax^2 + bx + c = 0$; one of the roots of this equation will be scheme capacity.

INPUT DATA

Initial Data. The data preparation is relatively short and conforms to normal requirements that would be made for manual calculations. These are divided into pipe line characteristics, properties of the product, and cost basis.

Pipe Line

1. Internal diameter of pipe
2. Equivalent lengths of various piping losses
3. Station and tank farm elevations
4. Maximum allowable working pressure
5. Minimum suction pressure
6. Elevation and relative location of any hills which might intersect the normal hydraulic gradient line
7. Four coefficients representing the pump head curve and likewise for the brake horsepower curve for each pump at each station
8. Number of each type of pump at each station
9. Constants in the straight line equation representing motor efficiency over the range of load used
10. Relative flow rates in each line segment.

Product

1. Viscosity
2. Specific gravity
3. A code number for the appropriate flow formula to be used.

Cost Basis

1. Contract rates for power being purchased
2. Minimum monthly power bill at each station
3. Operating labor cost at each station.

Additional Data. Additional studies of the same system can be made by changing only the new condition. For example, a change in the relative flows in each segment will reflect the result of injecting or withdrawing product. Or

a change in the characteristics of the fluid being pumped can adjust for seasonal temperature changes or a change in oil being received for shipment.

Program Restrictions. Certain limits that did not hinder the intended use of the program were included. These are:

1. Maximum of six pump stations
2. Maximum of four different types of pumps at any station (the number of each type is unlimited)
3. Electric motor driven centrifugal pumps
4. Flow rate changes can occur only at pump stations.

Of these limitations, the first two were imposed by computer storage size. These numbers could be increased by reassembling the program for running on a larger capacity machine. Since the program was written in the IBM Fortran language, this can be accomplished quite easily.

METHOD OF CALCULATING

General. The program can be divided into three broad categories: **hydraulics, cost,** and **cost analysis.** The first two, hydraulics and cost, are worked as a pair, so that once it has been determined that a particular scheme of pumps can move a given maximum capacity, the cost of the movement can be calculated. After these calculations are complete, the cost analysis examines the data to determine which combinations of schemes will deliver the product at the lowest cost.

Hydraulics. The first relative flow rates in each line segment must be supplied in the initial data. This should be low enough so the smallest possible number of units in the system will be employed.

The calculations are made segmentally, and only the results for all stations need be placed into memory. The pressure drop per mile is calculated according to one of three equations as determined by a code number in the initial data. These are the Wilson and McAdams Formula for crude oil, and Aude's Formula or the Hazen and Williams Equation for refined products.

Starting at a predetermined tank in the originating tank farm, the minimum number of tank farm booster pumps required to supply main line suction pressure is determined.

Two types of discharge pressures are calculated: *discharge pressure required* and *discharge pressure available. The pressure required* is the value read from a line friction curve, while the *pressure available* is gauge pressure.

The pressure required is the sum of line friction in the segment, adjustment for static differences of the stations, and pressure added to maintain positive pressure over any hills that would otherwise intersect the hydraulic gradient.

The pressure available is that pressure developed by the smallest number of pumps that is equal to or exceeds the pressure required. This is performed by beginning with the smallest unit added to suction pressure and compared to pressure required. Additional units are added in the least possible increments until sufficient pressure is available to meet pressure required.

While the normal suction pressure at the downstream station has been considered, this will usually be exceeded because of the unlikely possibility of perfect matches of the two discharge pressures. Also, any pressure added to raise the hydraulic gradient over the hill tops will ride through into the downstream station.

Repeating the same procedure for the remaining stations will then deliver the product to the line's terminus and will have determined a base scheme of pumps that will do the work.

There will be other pump combinations capable of moving the product through the pipe line. The legitimate alternatives to the base scheme will only be those that use no more installed horsepower than the base scheme. These alternatives are developed by splitting the line into two segments separated by a station; the upstream stations retain the same units as the previous scheme; the next higher increment of pumps is placed at the splitting station, subject to pressure restrictions and the availability of more pumps; recognizing the increased suction pressure at the next station, the minimum number of pumps required here is determined, as well as any other downstream stations.

The first alternative to the base is developed by splitting the line at the next to the last station. When no more pumps can be added at a station, the split moves upstream one station and proceeds in like fashion. When the first station is either at maximum allowable line pressure, or all units are in use, all possible alternatives have been determined.

While all alternatives now are capable of pumping the trial flow of the base scheme, and all use the same total number of pumps in the system, the maximum capacity that each scheme can achieve without throttling out any pressure will vary by an amount depending on the specific pipe line.

How to find each scheme's capacity. This is performed by an examination of "Unused Residual Pressure" coming into each station. *(Unused Residual Pressure is equal to gauge suction pressure minus normal minimum suction pressure minus pressure added to keep the hydraulic gradient above the hills. It would be throttled out if this flow were to be maintained, or is pressure now serving no purpose but which could be used to pump additional volume.)*

If the unused residual pressure is *plus* at all stations, more pressure is yet available and the capacity could be greater. A *minus* at one or more stations indicates an unworkable condition and the capacity has been exceeded. **Therefore, zero unused pressure is present only at the flow that is the scheme's capacity. In practice, ± 1.0 psi was used as well within the bounds of operating accuracy.**

The trial flow is somewhat less than scheme capacity, as noted. It was apparent that adding 500 barrels per hour to the trial flow rate would approximate the capacity. At this flow rate suction and discharge pressures are calculated at each station to determine the unused residual pressures. The sign test is made to determine if this flow is above, below, or at capacity. Since this first try will seldom be actual capacity, 200 barrels per hour will be added or subtracted, depending on whether this trial flow was below or above capacity as determined by the sign of the unused pressure. Thus a range of 400 barrels per hour is available to bracket the answers, and this is generally sufficient.

The capacity is normally between the two trial flows. The station having the least measure of unused residual pressure will be the controlling station. A straight line plot (Fig. 1, *A D)* is made of the controlling stations

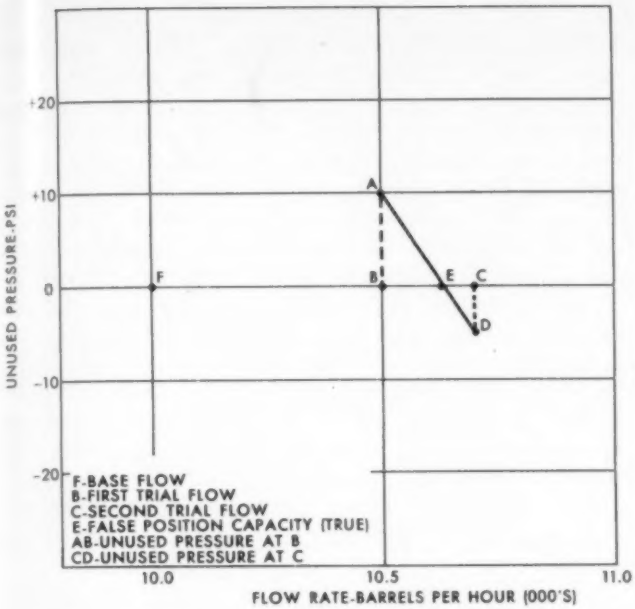


FIGURE 1—Determining capacity by false positioning.

unused pressures *(A B* and *C D)* versus the two trial flow rates. At zero pressure *(E)* is the forecasted flow which should be capacity. Suction and discharge pressures as well as unused residuals are calculated as above to verify this.

The straight line false positioning technique is correct even when the answer is slightly outside the 200 barrels per hour range of the trial flows. A safeguard was provided for any unusual circumstances where the capacity is at an extreme distance from the trial flows, and the false positioning was not the capacity. A second degree curve fit is made through the three unused pressures at the controlling station. The intersection of this curve with zero pressure is the forecast of capacity. Suction, discharge, and unused pressures will be calculated at this flow to verify the forecast as capacity.

The straight line false positioning is the final capacity calculation when the program is used as originally planned. The additional routine is protection against defining an error as the correct answer. The efficiency of the straight line fit, and the operation of the curve fitting technique are illustrated by this test made during the testing procedures: Note in Fig. 2 the negative unused pressures *A B* and *C D* for the first two trial flows. A straight line through *A* and *C* determined point *F* as the false positioning capacity. Calculation of pressures here, however, determined unused pressure equal to *E F* actually existed. A second degree curve fit through *A, C, E* then defined point *G* as capacity, and calculation of pressures verified this.

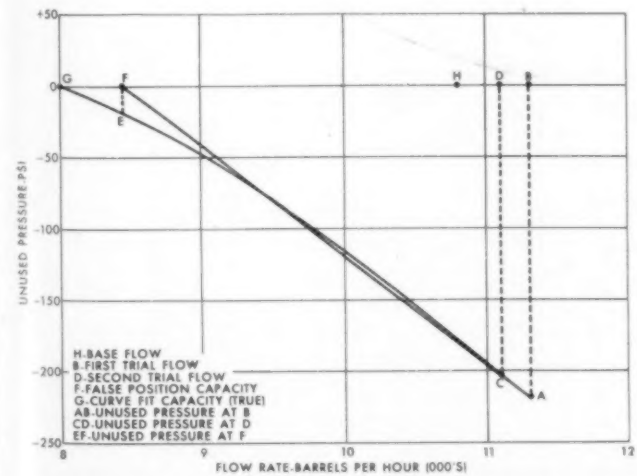


FIGURE 2—Determining capacity by curve fitting.

After the capacity of each alternative has been computed, the total brake horsepower at each station is calculated. As noted earlier, the brake horsepower curve of each type of unit is represented by a third degree polynomial equation. This equation is solved for horsepower at the flow equal to capacity, and multiplied by the number of this type of unit in use.

A straight line equation was found a good fit of motor efficiency versus flow, over the operating range This is used with the brake horsepower of each type of unit to calculate the kilowatts of power that will be drawn by the motor, and summed up by stations.

This completes the hydraulics calculations that will be made.

COST

As noted earlier, the total kilowatts of power at each station in each scheme has been calculated and carried forward. Because the costs are computed on a monthly basis, the energy in kilowatt-hours per month is easily calculated. Demand and energy satisfy the requirements for entering the power contract. Each station's contract for power rates was written as a specific program.

The separate demand and energy charge are retained intact. However, in summing up all station's costs for a scheme cost, the sum of each station's demand and energy is compared to its minimum monthly bill, and the larger, of course, is used. A system power cost per barrel is computed from the system monthly power cost.

An additional consideration other than power cost has been included, though not used. This is the labor cost for operating personnel at the pump stations. Included in the initial data is the operating cost for the normal station complement and the cost standby personnel that would be anticipated if the station were idle. Thus it would be possible to study the net effect of paying the minimum power bill at an idle station which had operating savings to offset this penalty. There might be many varied operating reasons for using this consideration that would best be decided when needed. The power plus labor cost is likewise calculated in a cost per barrel.

During the cost phase, the cost data is added to the hydraulic data to produce a comprehensive magnetic tape that retains all the hydraulics and cost breakdown for each scheme developed. The final result is the recording of the hydraulics and cost information for every possible pump configuration in the system.

At the same time a second tape is being prepared with a selected few of the lowest cost schemes. This tape has cost data for the lowest cost schemes recorded from each group of alternatives (the lowest from all schemes using the same number of pumps). It also contains what might be termed the "next best" and so on, should more exist (the "next best" is the lowest cost

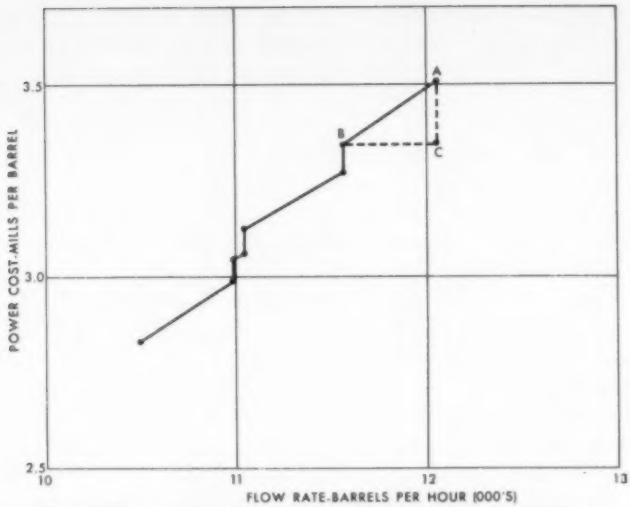


FIGURE 3—Plot of cost per barrel for all flow rates.

scheme of those whose capacity is greater than that of the lowest cost).

This completes the cost calculations that are made. As mentioned before, the hydraulics and cost are worked as a pair. At the completion of the cost phase the program becomes self-perpetuating in this manner: the scheme with the largest capacity has been recorded; by adding even 50 barrels per hour to this rate and re-entering the hydraulics phase at the beginning, a pump selection will be made and it must of necessity require one more pump than the previous calculation. The alternatives are developed, capacities found, and costs figured. This process repeats itself either until stopped or ultimate line capacity has been reached by using all the pumps in the system. In either case, the cost analysis is performed next.

COST ANALYSIS

The input to the cost analysis is the two tapes just noted: one containing hydraulics and cost data (the comprehensive tape), the other containing only cost data for the lowest schemes (lowest cost tape). The schemes on the comprehensive tape are arranged in approximate order of increasing flow rate, while the lowest cost tape is in exact sequence of increasing flow. Thus the last scheme on this tape has the greatest capacity and will be the first to be used in further calculations.

The purpose of the cost analysis is to find the one scheme from the comprehensive tape that when used for a part of a day in combination with a scheme from the lowest cost tape will achieve the lowest cost for the flow rates between them. In this manner, the system is operating without throttling out excess pressure at any time. While the pumping rate will always be above or below the daily throughput to be maintained, the exact flow will be attained by pumping at each of the two rates to average the desired throughput.

A scheme from the comprehesive tape must meet these specifications in order to qualify as a possible combination of a scheme from the lowest cost tape:

1. Flow rate less than that on the lowest cost tape.
2. No station may draw more kilowatts of power except if both schemes are already paying the minimum monthly bill.

For those schemes that qualify, the cost line *(A, B,* Fig. 3) is drawn between the two schemes, and its slope is computed *(A C/B C,* Fig. 3). Since these cost lines are radiating back out of the scheme with the higher flow rate *(A)*, it is seen that the line with the steepest slope will maintain the lowest cost for those flows immediately less than that of the lowest cost scheme *(A)*. These combinations are made until the capacity of the

ANY PIPE LINE COMPANY — SEGMENT: STATION A TO TERMINAL - NO INJECTION

PUMPING RATE TABLE AND POWER COST PER BARREL — CRUDE OIL: 85° F. 39 SUS 0.8130 SP. GR.

PUMPING RATES IN BPH AND NUMBER OF PUMPS				SCHEME	AVERAGE FLOW		HOURS PER DAY		POWER COST
STA. A	STA. B	STA. C	STA. D	NUMBER	BBL. PER HR.	BBL. PER DAY	HIGH RATE	LOW RATE	MILLS PER BBL.
10,810	10,810	10,810	10,810						
1	1/2	1/2	1/2	34					
					10,811	259,464	0.05	23.95	2.7530
					10,900	261,600	4.29	19.71	2.7811
					11,000	264,000	9.05	14.95	2.8126
					11,100	266,400	13.81	10.19	2.8441
					11,200	268,800	18.57	5.43	2.8756
					11,300	271,200	23.33	0.67	2.9071
					11,314	271,536	24.00	0.00	2.9115
11,314	11,314	11,314	11,314						
1	1/2	1	1/2	50					

FIGURE 4—Typical page from pumping rate table.

SCHEME NUMBER	BARRELS PER HOUR	TERMINAL RESIDUAL NORMAL	EXCESS	DOLLARS PER MONTH	MILLS PER BARREL
268	12985	25.0	0.4	39877.61	4.2069

	STATION A	STATION B	STATION C	STATION D
Bbl Per Hour	12985.	12985.	12985.	12985.
Sp Gravity	0.820	0.820	0.820	0.820
Vis - Sus	43.	43.	43.	43.
Installed Hp	5350.	3000.	1000.	1000.
Brake Hp	4447.	2526.	871.	863.
Kilowatts	3497.	1986.	689.	683.
Hill Press	0.0	0.3	1.5	0.0
Normal Resid	25.0.	25.0	25.0	25.0
Excess Resid	22.5	350.3	389.5	234.5
Dis Pr Reqd	306.8	335.8	273.9	351.8
Dis Pr Avail	657.2	725.0	506.9	352.2
Demand Chg	4806.94	2881.88	1016.91	989.28
Energy Chg	14839.69	8547.10	3567.84	3014.51
Station Cost	19646.63	11428.98	4752.00	4050.00

FIGURE 5—Typical page of a hydraulics report.

schemes on the comprehensive tape begin to exceed that of the lowest cost scheme being worked. As each slope is calculated it is compared with a location in which the previous greatest slope has been stored. Thus when all combinations have been made, the best has been retained in memory and both schemes of the combination are written on an output tape.

This procedure is continued until all the schemes on the lowest cost tape have been put into combination with a scheme from the comprehensive tape. The output tape at this stage could be summed up: *Use the following two sets of pumps; their appropriate pumping rates will be as follows; use these pumps between the following range of flows; the power cost per barrel at each end of the range is as follows; plus other data of an informational nature.*

The final calculations will add to this output tape the cost per barrel and the hours per day to pump at each rate in order to average every hundred multiple of flow between the two pumping rates. In addition, since the calculations have been performed in floating point form, the output data is converted to fixed point form and punched into cards for greater readability.

OUTPUT

Pumping Rate Table. A theoretical page of Pumping Rate Table is shown in Fig. 4. A complete book covers the range of flows from the lowest possible by using the single smallest pump at the first station, through system capacity using all pumps. Succeeding pages provide a continuity of flows.

The calculation of this table was the primary objective of this project. To use it, simply locate the one page that has the throughput forecast for the coming month. Of greatest importance is the definition of the maximum number of units to be run at each station. Thus options using fewer units are permitted, but the ceiling is set.

Hydraulics Data. The simulation of a pipe line obviously includes the calculation of the hydraulics data of the system. As noted before, the normal working of the program places this information on the comprehensive tape. The station-by-station build-up of cost also appears. While this was not one of the goals of the project, nevertheless its value is quite extensive. For information, then, this tape was printed out for the Engineeirng Department. Form of the data is shown in Fig. 5.

CONCLUSIONS

The use of the electronic computer has had these advantages over manual working of the problem:

1. The lowest cost methods of operation would not have been anticipated, and time would not allow working more than a few assumptions
2. The comprehensive hydraulic tape provides a complete hydraulics record of the system
3. A small program permits the searching of the comprehensive tape for specific operating conditions, such as maximum suction pressure at a station, the best operation of the system if certain pumps should be temporarily inoperable, and the effects of a changing minimum monthly power bill.

In addition the program has been used in conjunction with studies being made by the Engineering Department to calculate the hydraulics of other pipe lines.

At the present time there has not been sufficient usage to provide an accurate estimate of the savings being realized by the use of the program.

ACKNOWLEDGMENT

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H. A. Johns, manager of engineering, Gulf Refining Company, and the engineering staff of Gulf Refining Company were responsible for the basic concept of the Pumping Rate Table. The Programing Staff, Data Processing Center, Gulf Oil Corporation were of great assistance in writing the program for this problem.

About the Author

Paul Pancio, Jr. of Gulf Oil Corp.'s data processing center in Houston is a graduate of Rensselaer Polytechnic Institute. He joined Gulf in 1953 as a district pipe line engineer at Fort Worth. The following year he was transferred to Houston as design engineer. He was assigned as a programer analyst last year.

Centralized Dispatching on the Mid-America LPG System

By G. V. Rohleder, General Superintendent, Mid-America Pipe Line Company, Tulsa

William F. Haley, Product Manager, Systems, Union Switch and Signal Division of Westinghouse Air Brake Company, Pittsburgh

MID-AMERICA PIPELINE COMPANY system is the first ever designed exclusively for propane, although it can carry other products. The line is comprised of 1,700 miles of trunk line and 480 miles of gathering lines that tie the system to some 30 gasoline plants in the southwestern United States. (PIPE LINE INDUSTRY has published several descriptions of the system, see the November 1960 issue and also another article in this issue.

The system has 15 pump stations with a total of 13,600 horsepower. All of the pumping units are motor-driven centrifugals with mechanical seals. The company owns operating terminals at Hobbs and Conway and delivery terminals at Greenwood, Neb.; Sanborn, Iowa; Pine Bend, Minn.; Kearney and Moberly, Mo.; Iowa City, Iowa, and Janesville, Wis. Each of the terminals has above-ground storage tanks, metering equipment, tank and rail tank car loading racks. Only trucks are loaded at Moberly.

Two underground storage caverns are located at Hobbs, N. M. Each has a capacity of 150,000 barrels. Six 1,500-barrel horizontal propane pressure tanks also will be located here.

Where the system divides at Conway, there are three underground caverns, six 1,500-barrel propane tanks. To supplement Mid-America's storage, there are five underground facilities owned by other companies. Two pump stations (one for each leg of the pipe line), a 10-inch switching manifold, and dehydrating equipment complete the main installations. All of these are controlled from the Conway terminal.

Terminals on the southern and northern parts of the system, with the exception of Pine Bend and Janesville, will have two truck loading docks and two loading pumps each capable of loading 500 gallons per minute. Pine Bend and Janesville each will have four truck docks and four loading pumps. Positive displacement meters will be used for all custody transfer and will be calibrated with a piston pipe prover. At each of the delivery terminals, including Hobbs and Conway, turbine meters are installed to provide means for inter-company checking. Two dehydration units, each capable of drying 1,500 gallons of product per minute, will be located at Conway and Hobbs.

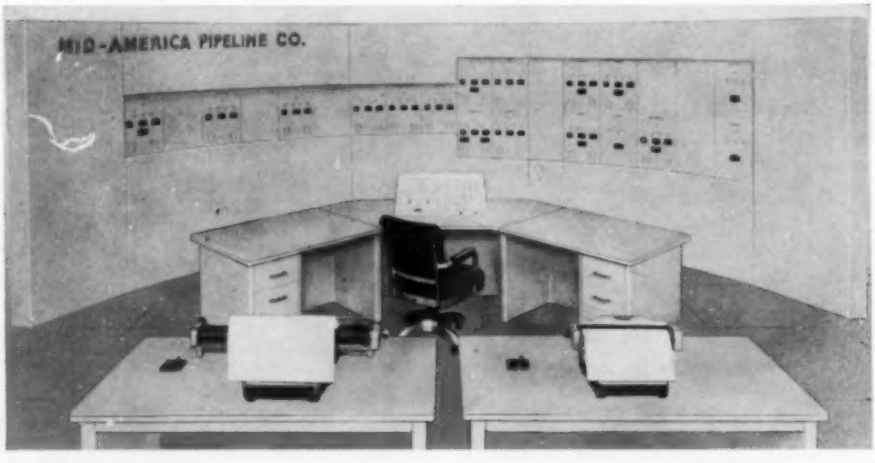

FIGURE 1—Control and monitoring center in the Tulsa Dispatch office. All main line operations are controlled from this console and data display. This arrangement supplies the dispatcher with all information necessary for operations and a means of implementing it by pushbutton.

Tulsa Dispatch Center. Mainline operations are controlled from a central dispatching office in Tulsa and the gathering system will be controlled from a central point at Hobbs. The ultra-modern Centralized Transport Control (CTC) console and data display shown in Figure 1 is the focal point for all control and monitoring functions emanating from Tulsa. This progressive innovation of CTC places at the fingertips of the dispatcher all of the information necessary to efficiently operate the pipe line.

The dispatcher's needs for operating information have dictated the basic design. Current, pertinent data for the entire pipe line are continuously displayed. General operating information on any critical condition is presented immediately and automatically for the dispatcher's decision. A rigorous control philosophy is designed into the equipment which includes all of the features required for completely integrated control.

At pre-set intervals of 15, 30 or 60 minutes—whichever is preferred—each station will be roll-called and all operational data will be read out on indicators within the curved panel. At the same time, this data will be printed out in horizontal line on log-sheets in two typewriters. While the delivery information is coming into the panel, a red lamp will glow at the various stations to indicate to the dispatcher that data is arriving. When the red light goes out, data for those stations will be up-to-date.

Figure 2 shows a close-up of the individual segments that comprise the total data display for the pipe line. Pressures and meter totals are displayed on digital indicators. Various colored lamps provide information regarding status, change of status, and alarms.

In event an uncalled for change occurs at one of the stations, an amber lamp will light up to inform

the dispatcher that a mechanical or electrical fault has occurred.

The control console shown in Figure 3 is the dispatcher's tool for controlling the pipe line. Using the displayed information from the field stations, the dispatcher makes decisions regarding normal and emergency changes in the line status and initiates them by manipulating the appropriate buttons on this console. By emergency measures here we are referring to changing the upstream or downstream stations to account for the loss of the in-between station. Station and unit sequence control cabinets have integral emergency shutdown features so that the station or unit protects itself by shutting down, completely independent of respective communication links with Tulsa.

The operation of the Transport Control Center is simple and convenient. To initiate a control function at a given station, the dispatcher simply selects that station and function by pushing the appropriate buttons on the console. Only one control can be sent at a time. The dispatcher pushes the station pushbutton thereby causing it to illuminate. Then he must push the function pushbutton causing it to illuminate. It is then only necessary for the dispatcher to depress the *Code Send* pushbutton to complete initiation of the control code transmission. After the *Code Send* pushbutton is depressed, the selected station and function pushbuttons remain locked and illuminated until completion of the control code. At this time, the console board is automatically reset and ready for another operation. In the event that the dispatcher pushes a function pushbutton and a station pushbutton where that function does not exist, an interlocking circuit detects the invalid command, causing the *Invalid* pushbutton to be illuminated. The console must then be reset by pushing the *Invalid* pushbutton. Similarly, if the dispatcher were to attempt to send more than one function at a time, the attempted invalid operation would be detected, and he must push the *Invalid* pushbutton to reset the board.

The pushbuttons and lamps on the console are as follows:

1. Indicating Lamps

Each of the three code control systems has two indicating lamps to monitor the control system operation. The *Control* lamp indicates when the system is transmitting and the *Indication* lamp indicates when the system is receiving.

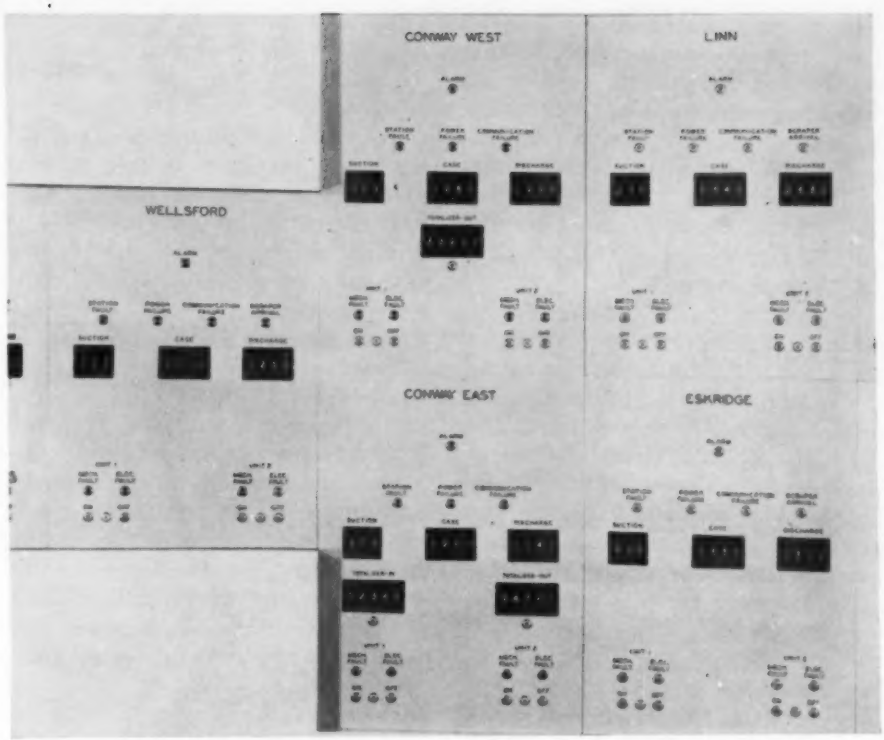

FIGURE 2—Close-up of the individual segments comprising total data display for the pipe line system. Pressures and meter totals are displayed on digital indicators. Various colored lamps provide information regarding status, change of status and alarms.

A lamp within the *Invalid* pushbutton will illuminate if the improper combination of pushbuttons is operated. In event the status of the control console is changed while a control code is in progress, the code will be rejected and the operator will be notified by the illumination of the *Invalid* pushbutton. The *Check Readouts* lamp will illuminate if there is a malfunction of any digital readout instrument.

2. Station Pushbuttons

Three rows of pushbuttons, appropriately labeled, provide for the selection of field stations.

3. Function Control Pushbutton

Function pushbuttons pertaining to *Unit 1, Unit 2, Pressure Set Point, Delivery Set Point, All Station Meters-Reset or Rollcall, Totalizing Meters Reset,* and *Station Check* provide for the selection of the particular function to be performed at a field station.

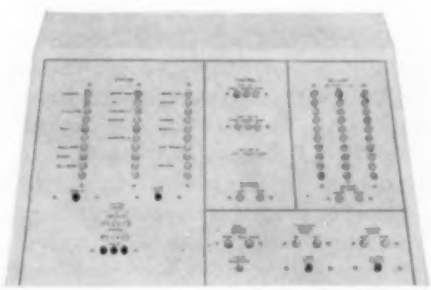

FIGURE 3—Dispatcher's control console. This is the dispatcher's tool for controlling the pipe line.

4. Auxiliary Control Pushbuttons

The auxiliary control pushbuttons perform to the following:

a. *Lamp Test* pushbutton (spring return) when used in conjunction with the particular station pushbutton is used for checking display lamps.

b. *Alarm Silence* pushbutton (spring return) is used to silence the audible alarm.

c. *Invalid* pushbutton (spring return) is used to manually reset the control board.

d. *Code Send* pushbutton (spring return) is used to initiate transmission after the specific station and function pushbuttons have been selected.

e. *Cancel* pushbutton is used to stop undesired code transmissions while coding is in progress.

Control pushbuttons for *Unit 1* and *Unit 2* are used to *Start, Stop* or *Reset* the Pump Units, at the location determined by the station pushbutton depressed.

The *Pressure Set Point* pushbuttons, *Low* and *High,* provide a means for selecting either the high or the low suction pressure set point.

Three rows of *Delivery Set Point* pushbuttons provide the selection of the desired quantity (in barrels times

ten) of product to be delivered. The quantity selection ranges from 0000 to 9990. When the quantity selection has been made and the *Code Send* pushbutton depressed, a code is transmitted to the selected delivery station to: (1) establish a digital quantity, (2) start delivery, (3) monitor the amount delivered, and (4) automatically stop delivery.

Depressing the *Totalizing Meters Reset-In* pushbutton along with either the *Conway East* or *Conway West* pushbutton causes the incoming totalizing meter at Conway to reset. The outgoing totalizing meter at Conway East is reset by depressing the *Totalizing Meters Reset-Out* pushbutton along with the *Conway East* pushbutton. Similarly, the Conway West outgoing totalizing meter is reset by depressing the *Totalizing Meters Reset-Out* and the *Conway West* pushbuttons, and the Seminole outgoing totalizing meter is reset by depressing the *Totalizing Meters Reset-Out* and the *Seminole* pushbuttons.

Station Check pushbuttons identified as *Lamp* and *Data* are used to recall lamp indications and numerical data from the various field stations.

All programming of pressure and flow data logging takes place in the respective pressure and flow logger racks located at the Tulsa office. Data and flow loggers operate independently of each other. A permanent record of all data is recorded by IBM typewriters on logging form sheets. The logging format is fixed for each logging operation. This format can be changed if necessary by rearrangement of patchboard jumper wires. The actual time-of-day is logged at the beginning of each logging operation regardless of the cause for logging initiation. Selector switches are provided in the logger racks which enable the dispatcher to choose the automatic time logging cycle that he desires. In addition to the cycle selector switches, the logger racks contain a *Telelog* pushbutton which when depressed initiates a logging cycle, and a *Log Cancel* pushbutton which cancels the logging cycle. Canceling of the logging cycle may be necessary due to some malfunction of the typewriter such as jammed keys or similar difficulty. Data logging of either pressure or flow information can also be initiated by depressing the *Demand Printout* pushbutton located on the control panel of each typewriter.

A station which was requested to report on *Rollcall* and has failed to do so causes the typewriter to print dashes (- - - -) in place of the old data.

When the communication circuits are lost to one or more field stations so that their data readings are no longer up to date, a slash (/) is printed in front of each last known data value for the stations out of communication.

1. Pressure Data Logging

Pressure data logging is initiated by a pulse from the digital clock at regular predetermined intervals of 15, 30, or 60 minutes. Interval selection pushbuttons are mounted on the pressure data logger rack to permit the operator to choose the desired automatic time logging cycle. The pressure typewriter will print out the time, the suction pressure, the case pressure, and the discharge pressure for all field stations.

2. Flow Data Logging

In addition to the different logging cycles mentioned in preceeding paragraphs, logging of flow data is initiated by the following operations:

a. Depressing the *All Station Meters-Rollcall* pushbutton will initiate a common control code over all three code systems requesting flow data from all field stations. Stations in the act of delivering report their latest product delivery readings. Stations not delivering do not report.

Metering stations report their current totalized readings. After the last product delivery, data is reported and displayed on the readout instruments, all the data is automatically logged with all data in black print.

b. Depressing the *All Station Meters-Reset* pushbutton will initiate a common control code over all three code systems to all field stations requesting reset operation and flow data. Stations delivering will report their latest P.D. readings. Stations not delivering will reset to zero and report zero.

Metering stations will report their final totalized readings, then reset to zero. After last P.D. data is reported and displayed on the readout instruments, all the data is automatically logged with the data for the metering stations printed in red, and the letter *"R"* (signifying reset) precedes each totalized reading. The red printouts have a double meaning—the actual final total and its implied new zero. The letter *"R"* conveys that information to a tape punch in the event one is used in the future.

c. A totalizing meter can also be reset individually by command. When the metering station resets, it reports its final total reading, and it initiates automatic logging. That meter's reading is printed in red, preceded by the letter "R." All other readings logged are not current.

Communication Link. Communications channels are leased lines. There is one channel for teletype and another for supervisory controls. The control center is linked to the various stations by means of these leased lines. Coded signals, a different one for each control function, are initiated at the control board and travel over the leased circuit to a station or terminal. When they arrive, the coded signals actuate relays that carry out orders of the dispatchers. Codes are initiated by pushing a button on the central control board, by a change of status in the field, or by a change of data in the field.

Three separate code systems (see Figure 4) comprise the complete control facility for this pipe line.

Code units located at field stations that are linked to separate code systems at the Tulsa office can report simultaneously. If two field stations on the same code system start to transmit at the same time, a code preference is established and transmission takes the following order:

1. Controls or delivery set point commands from the office
2. Lamp indications from the field
3. Data quantities from the field.

One of the important factors in this CTC facility is system discipline. Rigid discipline is necessary to prevent mutual interference, assure orderly handling of all data, and preclude loss of information. To assure such discipline, this CTC code system:

1. Detects and rejects codes distorted in transmission
2. Coordinates code assignments initiated simultaneously
3. Automatically handles code information for orderly transmission
4. Removes a station from the line if another station has information to transmit
5. Provides a means of cancelling control codes placed in storage
6. Automatically recalls invalid indicating codes
7. Provides a means of recalling indication codes on demand
8. Gives preference to a contr

code over an indication code from the field.

Product Delivery Stations. Product delivery facilities are provided at Greenwood, Sanborn, Minneapolis, Kearney, Moberly, West Branch and Madison. At these stations, delivery can be accomplished remotely by having the dispatcher transmit the desired *PD Set Point*. Local control of delivery is also possible, in which case the attendant must operate the *Start* and *Stop* pushbuttons which are made operable after first unlocking the *Key* controller.

1. Supervised Delivery Control

When the *PD Set Point* (in 10 barrel units) is established, and the station at which this product delivery is to be made has been selected by the dispatcher, the control code is transmitted by depressing the *Code Send* pushbutton.

Product delivery is effected at a delivery station upon receipt of the control code establishing the *PD Set Point* value from 0000 to 9990 and the delivery command. The *PD Set Point* values are registered as digital quantities in a relay storage bank and the delivery command initiates a control means for opening the delivery valve.

Concurrently with the above action, counters that register the quantity of delivered products are positioned to zero; this condition is read into storage relays and a data report code is transmitted to the Control Center. There, an indication of this data is displayed so a manual check of the zero point can be established.

When the delivery valve makes its initial opening movement, the field station transmits a valve *Open* indication to the Control Center. The delivery valve continues its movement to a full open position.

During the delivery cycle, delivery can be terminated short of the *Set Point* value by a *Delivery Stop* command code from the Control Center. Delivery will also stop if A.C. power should fail at the delivery point. Furthermore, delivery may be terminated locally at the delivery station by manipulation of the *Key* switch and delivery *Stop* pushbutton.

If AC power fails during product delivery, a check valve will close to stop delivery. When AC power is restored, the delivery valve will close automatically and remain closed until a new *Set Point* is established. A data code will be transmitted to the Control Center indicating the quantity of product delivery.

FIGURE 4—Communication line circuits for the Mid-America system.

A change or correction in *Set Point* value can be made during a delivery cycle without stopping delivery, provided the new *PD Set Point* value is greater than that contained in the counter.

Automatic termination of delivery occurs when the digital count of the delivered product units registered in the PD counter agree with the *PD Set Point* value. When this match point is reached, the delivery valve is closed. An indication that the delivery has stopped and the data reading of the product quantity delivered is transmitted to the Control Center.

The *PD Set Point* and final delivery count is maintained at the delivery station until a new *PD Set Point* or a *Reset* command is received.

Product delivery *Without Set Point* can be made at a delivery station by sending a *Delivery Start* command to open the valve which will remain open until it is commanded to close. The control code to accomplish this action actually establishes a *PD Set Point* at the delivery station of 10,000. Even though the counters could count 99990, the *PD Set Point* matching capabilities are only 9990; therefore the set point cannot be matched and the delivery valve remains open until a *Stop Delivery* control is received. Of course, delivery may be stopped locally as previously stated.

While stations are delivering a product, data codes representing intermediate delivered quantities may be reported upon receipt of a *Roll-call* command from the Control Center. However, when product delivery has been completed and the data readings of the last delivered value has been transmitted, the *Roll-call* code will not recall the reading from the stations not delivering; however, an individual *Recall* code will cause this data to be transmitted to the Control Center.

2. Local Control of Product Delivery

Each product delivery station is provided with a Delivery Local Control Panel for the purpose of initiating and/or stopping product delivery manually. An indication light on this panel, is lighted when a delivery is being made. A *Key* lock switch, when operated, activates the *Start* and *Stop* pushbuttons. Delivery is started by de-

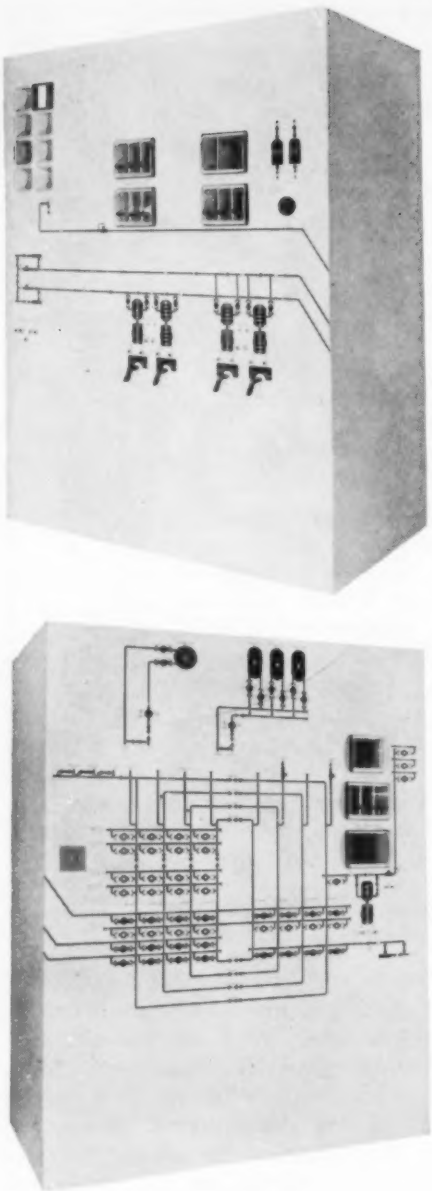

FIGURE 5—Instruments for measuring the variables for subsequent digitizing are mounted in the cabinets. Lamps indicate the status of all valves, in the piping configurations shown.

pressing the *Start* pushbutton and is terminated by depressing the *Stop* pushbutton. The delivery action is similar to that described for *Delivery Without Setpoint*. The dispatcher is informed of delivery in the same manner.

Each delivery station is provided with a toggle switch within the *PD* cabinet which when placed in the *Off* position, permits maintenance work on the delivery valve without the danger of unintentional operation. The switch must be placed to the *On* position to restore delivery valve operation.

Metering Station. Conway and Seminole are equipped with Main Line Turbine Meters to provide totalizing data of products passing those stations. Here the counting range per each metering facility is from 00000 to 99990, representing product units of 10 bbls. each.

The product count is accumulated, starting from zero, as the product passes a metering point. An individual report from any particular metering point can be obtained by depressing the specific station pushbutton along with the *Station Check-Data* pushbutton. To obtain a meter reading for the Conway station, either the *Conway West* or *Conway East* pushbutton and the *Station Check-Data* pushbutton must be depressed.

An *All Station Meters* (metering and delivery)—*Rollcall* command results in all metering stations reporting their latest totalized reading, and such delivery stations as may be be delivering, reporting their latest *PD* data to the Control Center.

An individual *Totalizing Meters Reset-In* or *Out* command, received at a specific metering station, results in a final totalized reading from the counter, and it is reset to zero. The counter immediately starts counting a new total, and the station transmits the previous totalized reading to the Control Center.

A common *All Station Meters* (metering and delivery)—*Reset* command results in stations that are making a delivery reporting their latest *PD* readings, and those stations not delivering resetting to zero and reporting such zero readings. All metering stations report their final totalized reading and reset to zero.

Because stations are unattended for the most part, protection against abnormal operating conditions is provided by monitoring devices that automatically detect dangerous conditions, shut down motors, and prevent them from re-starting. Sequence equipment used to start and stop pumping units is designed with emphasis on reliable components and circuitry that requires a minimum amount of care and maintenance. If there is a failure of equipment anywhere on the system, protective devices will prevent damage to other parts of the pipe line system.

Figures 5-A and 5-B show field cabinets. Instruments for measuring the variables for subsequent digitizing are mounted in the instrument mounts shown. Various control buttons are provided for use when station or unit is placed under local control through the operation of the SB-1 switch (large black handled switches). Lamps indicate the status of all valves in various piping configurations selected.

Operation. This control system went in operation last spring, and it has been operating satisfactorily by automatic controls as discussed here ever since.

ACKNOWLEDGMENT

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About the Authors

Rohleder

Haley

Gilbert V. Rohleder has spent 15 years with Tulsa-based pipe line firms. He joined the new Mid-America Pipeline Company as general superintendent in charge of operations. Prior to this he was a director and chief engineer of the Okan Pipeline Co. He attended St. Joseph's College and Military Academy in Kansas; during World War II he served in the Second Infantry Division. In 1945 Rohleder entered Massachusetts Institute of Technology, receiving his degree in mechanical and industrial engineering in 1948. He was with Service Pipeline Co. from 1948 until 1955 when he joined Okan.

William F. Haley attended the School of Electrical Engineering at the University of Pittsburgh from 1948 to 1952. He became an employe of Union Switch & Signal Division in March 1952 in the Simulator Engineering Department. Three years later he headed the Air Force Flight Systems Acceptance Group. After one promotion he joined the General Apparatus Department where his work involved pipe lines. In November 1959 he was appointed district manager for pipe line systems in Houston. In May 1961 he was appointed Product Manager, Systems. He is now responsible for systems marketing and engineering for pipe line, communications and process industries.

Modern Design and Automation

Special Design Features That Have Paid Off on LPG Line

A year's operation of the Mid-America system proves the efficiency of its design and planning

THE MID-AMERICA PIPELINE COMPANY system is an example of modern design for a special pipe line purpose. It has completed a shakedown, and is now transporting LPG from the Permian Basin of West Texas and southeastern New Mexico to points near Minneapolis, Minn., and Janesville, Wis. Few People—even the engineers saddled with the task of designing and constructing the lines—realize the true extent of such a project. In this instance, a recap of operations revealed that it required a hundred engineers, draftsmen, and clerical personnel to issue the 1,000 design drawings and 500 aerial alignment sheets. The purchasing group had to issue more than 3,000 purchase orders to provide the materials that went into the line, including such items as 110,000 tons of line pipe, 10,000 tons of coal tar enamel, 65,000 squares of polyethylene tape and 430,000 squares of glasswrap. The material list also included 140 mainline valves, 750 cathodic test stations, 1,900 aerial markers and 4,300 pipe line markers for the system.

Personnel outside the engineering department included 100 in survey gangs, 60 right of way men (to contact the 4,500 property owners), 100 clerical personnel (to search titles) 140 men in warehouse operations, seven pipe line construction spreads, and seven inspection crews.

Data and Statictical Sources. It takes considerable information aside from handbooks and catalogs to plan and design a pipe line. The first study was necessarily concerned with the market demand and the supply of LPG which could fill that demand. This information was obtained from statistical sources of the American Petroleum Institute and the Bureau of Mines. They indicated that the consumption of LPG in the states to be served by the proposed line would be in excess of 40,000 barrels per day. Statistical data also indicate that the production of LPG in the area which is accessible to the pipe line in the Permian Basin and along its traverse in the Texas-Oklahoma Panhandle areas presently exceed 150,000 barrels per day.

Contracts were then let to purchase the necessary supplies of LPG for the expected market.

The consumption of LPG in the market area has an extreme peak in winter months. The expected consumption during December, for example, is about twice the average monthly consumption during the year. Thus it was necessary to design pumping facilities sufficient to transport about double the average daily requirements. This problem could be

MID-AMERICA SYSTEM. Line sizes, pumping horsepower, capacity between stations are shown in tables 1 and 2.

alleviated somewhat if economical seasonal storage was available in the major marketing areas.

Nature of the Product. The beginning point in the design is a thorough understanding of the nature of the product. LPG may be transported safely so long as it is confined under pressure and controlled by prescribed and approved equipment in conformity with codes and regulations governing the design, construction and operation of LPG systems.

LPG is intermediate between a natural gas and gasoline. Its ingredients are predominantly propane and butane.

The designs of the pumping transfer and loading facilities were conceived with the premise that the initial system will handle a common commingled stream of propane which conforms to the specifications as set forth by the Natural Gasoline Association of America's (now NGPA) latest revision to its Publication 2140. However, this pipe line is designed so it can economically transport additional products if the tenders are fairly large and the throughputs are sufficient to justify storage of these products. The average pumping capacity of the system will be reduced somewhat when products are tendered that have a specific gravity greater than that of propane. Design of pumping facilities was based on the specific gravity of butane.

Although propane exists in the gaseous state under normal atmospheric temperature and pressure conditions, it can be readily liquefied by reducing the temperature, increasing the pressure, or a combination of both. It can then be transported, stored and handled as a liquid if control equipment is installed on all pumping and storage facilities to maintain the product in a liquid state. Suitable equipment and design greatly minimize its hazard.

Product Specifications. Here are some of the specifications governing the product: Propane accepted for transportation at the gasoline cycling plant or underground storage point must be composed predominantly of propane as described by the latest NGAA test methods and shall conform to the specifications of NGAA's Publication 2140. The product shall also be free of all inorganic compounds.

Propane with these same NGAA specifications will be delivered to tank cars and tank trucks. Because propane produced from natural gas is

TABLE 1—Mainline Sections Design Pumping Data Summary

Operating Section	Size of Pipe	Length In Miles	Initial Capacity of Propane in BPD
Hobbs—Pampa	8⅝" x 0.219"	230	36,000
Pampa—Conway	10¾" x 0.250"	288	51,000
Conway—Greenwood	8⅝" x 0.219"	195	32,000
Greenwood—Sanborn	8⅝" x 0.219"	174	25,000
Sanborn—Pine Bend	8⅝" x 0.219"	163	25,000
Conway—Kearney	8⅝" x 0.219"	180	32,000
Kearney—Iowa City	8⅝" x 0.219"	298	20,000
Iowa City—Janesville	6⅝" x 0.188"	153	13,000
Artesia—Hobbs	4½" & 6⅝"	110	Varies
Keystone—Hobbs	4½", 6⅝", & 8⅝"	64	Varies
Snyder—Hobbs	4½", 6⅝", & 8⅝"	307	Varies

colorless, tasteless and odorless, the National Board of Fire Underwriters Pamphlet 58 requires that odorants be added to all marketed propane. Upon notice from the shippers, the propane will be odorized with ethyl mercaptan at the tank truck or tank car. No provision has been made for odorizing propane being transported in the pipe line.

Product specifications are maintained while in the pipe line and also after storage in the underground caverns at Hobbs and Conway. Shipper's propane received at Conway will be dehydrated for a charge of two cents per barrel or the shipper may dehydrate his own product if he desires.

Design Statistics and Facilities Summary. A schematic pipe line route is shown in an accompanying illustration. The pipe sizes, length of operating sections, and the maximum design pumping capacities of propane for each section are shown in Table 1.

Aside from quantities of materials listed earlier, it should be noted that approximately 10 miles of heavy wall pipe was used in crossing 30 major river crossings and numerous minor river crossings.

This year, some 32 gasoline cycling plants will be connected to the system. Others will be connected as shippers require. More than 30 million gallons of propane was required from these connected plants to fill the line.

Table 2 summarizes facilities installed at the pumping stations and terminals. It also summarizes the pipe line tariffs to various distribution terminals on the system.

In addition to the facilities mentioned above, large capacity dehydrators were installed at the Hobbs and Conway terminals. These dehydrators use alumina desiccant and each has a rated capacity of approximately 50,000 bpd. Hobbs has one unit and two are installed at Conway.

The motors installed at the mainline pumping stations have sufficient capacity for future pumping rates, even though several of the stations will operate at the maximum station discharge pressure of 1,440 psi.

The truck and tank car loading pumps at the distribution terminals are sized to load at approximately 500 gallons per minute. Small dissipating chemical type dehydrator units are installed between the loading pumps and the truck loading facilities.

Testing the System. The pipe line system was tested with 100 psi air at the completion of each day's construction. The section was then cleaned with air-propelled scrapers. After a sufficient length of line became available, it was filled with water and corrosion inhibitor and hydrostatically tested to at least 110 percent of the maximum working pressure.

Since propane has a great affinity for water and will not meet commercial specifications with even small amounts of entrained water, it was essential that this water be completely removed after testing. It was necessary to run numerous air-driven displacement-type scrapers to displace the test water.

Low dew point natural gas was then used to displace the air in the pipe line. Separation scrapers were inserted and propane injected into the line and, for practical purposes, the operation of the pipe line system had begun.

Design for Operational Efficiency. Custody transfer of the product is made by positive displacement type meters at the gasoline plant or underground storage location. Pressure and temperature corrections are made to this meter reading according to NGAA and API standards. The shipper furnishes the pipe line company with a certificate of product specification. The minimum consignment is 10,000 barrels of propane during a 48-hour period.

The gaging foreman at the district office in Hobbs and Liberal, Kan., is responsible for gathering the product

TABLE 2—Pumping Station and Terminal Facilities Data Summary

Location	Pumping HP Installed	Aux. HP Installed	Above Ground Storage	Rail Loading Spots	Truck Loading Spots	TARIFF FROM (In cents per bbl.) New Mexico W. Texas Group	Texas-Okla. Group	Conway-Hutchison
Midkiff, Tex.	200							
Hobbs, Tex.	1400	500	2–75,000 bbl. (caverns) 6–63,000 gal.					
Levelland, Tex.	1400							
Tulia, Tex.	1400							
Pampa, Tex.	1000							
Beaver, Okla.	1000							
Wellsford, Kan.	1000							
Hutchinson, Kan.	200							
Conway (McPherson) Kan.	2400	925	3–50,000 bbl. (caverns) 6–63,000 gal.	..	..	50	35	..
Linn, Kan.	1200			..	..	50	35	..
Greenwood (Omaha), Neb.	1200	100	2–63,000 gal.	10	2	68	53	28
Sanborn, (Sheldon), Ia.	1200	100	3–63,000 gal.	10	2	83	68	43
Pine Bend (Minneapolis), Minn.	....	200	5–63,000 gal.	10	4	95	80	55
Eskridge, Kan.	1200							
Kearney (K.C.), Mo.	1200	100	2–63,000 gal.	5	2	65	50	25
Moberly, Mo.	....	100	2–63,000 gal.	..	2	77	62	37
Iowa City, Ia.	700	100	3–63,000 gal.	10	2	88	73	48
Janesville (Madison) Wis.	....	200	5–63,000 gal.	10	4	100	85	60

and for preparing schedules to receive the product from various shippers. He communicates with the shippers by way of VHF-UHF radio. He can also communicate directly with the central dispatching office in Tulsa.

The dispatchers in Tulsa will coordinate the activities of the gathering and distribution operations in addition to controlling each pump station and distribution point between the origin and terminus of the pipe line. Pressure and flow conditions at pump stations, terminals and takeoff points are telemetered to this central dispatching office, where records are made for billing purposes as well as for a more efficient operating system.

Because Mid-America owns the line-fill, it is possible that a shipper may tender propane to the pipe line at the origin and simultaneously withdraw propane at any destination he may choose on the line. The key to successful operation of this pipe line or any other pipe line, lies principally with the dispatcher and his ability to plan and forecast operations; however, the dispatcher can only be as accurate as the information received from communications and remote control facilities and upon accurate forecasts of product requirement. A full period teletype network interconnects the Tulsa dispatching office with all critical operating areas. Half duplex DC channels are leased to transmit coded information on pressures, volumes delivered and flow conditions. A UHF-VHF radio system has been installed in areas where the product will be received from cycling plants.

Underground storage is provided for operating purposes at the Hobbs and Conway terminals. Dehydration facilities with capacities equal to, or exceeding pipe line delivery rates were also installed at these locations. Regardless of the amount of underground storage, some aboveground pressure storage must be provided for quality control and to maintain the desired rates to the pipe line. Although the system is presently designed for the transportation of propane, additional products may be transported in the system with only minor changes required in terminal and pump station piping designs.

The volume of product at delivery points is controlled from automatic pre-set signals initiated by the dispatcher. Product specifications are then checked in the tankage by the operator before loading into tank trucks or tank cars. Custody of the propane is transferred to the shipper, or his licensee, trucks and tank cars at the distribution terminals. Facilities have been provided to load at 500 gallons per minute at each truck spot. The custody transfer of the product is made by positive displacement-type meters, in accordance with API Standard 1101.

Maintenance. For the most part, maintenance of an LPG system is similar to that of any other products line. One departure, however, comes in the location and handling of leaks, and the making of line cuts. With an LPG line, these are major undertakings.

Take for example the problem of cutting into a propane line. The practice of digging a pit to hold the drainage until it can be pumped back into the system is out. The fire hazard of the highly volatile product rules this out. One method has been to evacuate the line by use of a portable pump and tank trucks. Obviously, this is expensive.

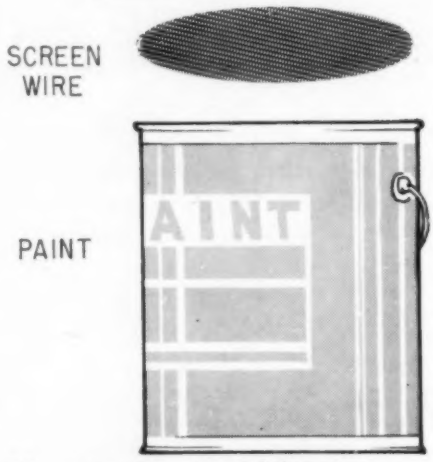
The ground is invariably frozen at a leak as a result of the evaporation of the leaking propane, and uncovering the pipe is difficult. Large leaks usually require a shutdown, but this does not stop the escape of product. Generally, the only recourse is to shut down, eliminate all possible sources of ignition, move people out of the area and close all nearby roads. Mainline block valves on each side of the leak should be closed as soon as possible. If there is considerable distance between block valves, the hazard in the leak area can be reduced by tapping the line at a safe location between the blocked valves and flaring the product. If the leak is large enough, all of the volatile material will have escaped before anything can be done.

Because the ground will be frozen in the leak area, pipe and the necessary fittings are stocked at strategic locations along the system so a temporary line can be laid around the leak location without waiting for the line cover to thaw.

The most troublesome type of leak which may be encountered is one which requires many hours or even days for the product to vent itself between any valve closures. For leaks in this category, tapping and plugging machines will be used to confine the product loss to a relatively small section of the line. Tapping and plugging equipment are available which are effective in blocking propane under high pressure, i.e., the plugging equipment will hold the vapor pressure of the propane, plus a reasonable static head. The tapping machine is part of the standard equipment used by each maintenance crew.

Early detection and immediate correction of leakage is just as essential to a propane pipe line as to lines transporting natural gas, gasoline and other similar products. Early indication of leakage is sometimes noted by discrepancies between meter readings on the delivery and receiving ends of the line. Periodic vegetation surveys conducted along the entire line by experienced personnel to observe whether vegetation is dying is another leak detection method.

As with most pipe line jobs, the success of this one, from the standpoint of design and construction, hinged on the cooperation of the many personnel engaged in carrying out the project. Not least among those who should be commended are the equipment suppliers whose enthusiasm and ability to respond to requests for "materials required yesterday" never wavered.



How to Strain Old Paint

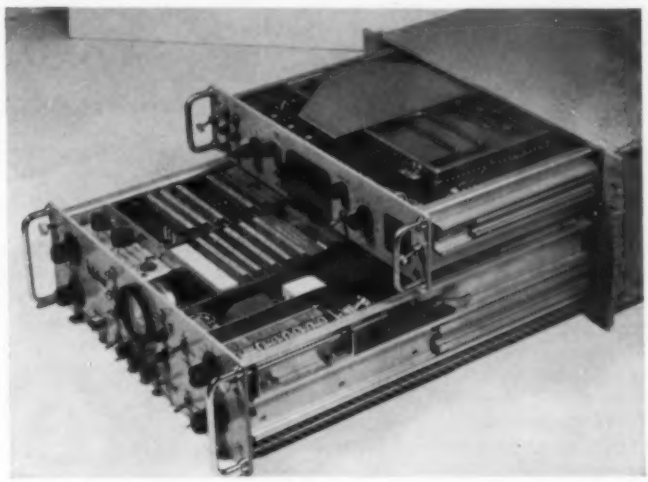
Let's say the bucket of paint was opened some months earlier, and has a scum on top. First, skim off the top, then mix thoroughly. Add thinner if necessary and condition the paint for use. To remove the last few lumps that remain, cut a piece of door screen the size of the inside of the bucket, insert it and work it to the bottom. This will carry the lumps to the bottom too, and the rest of the paint will be satisfactory for painting.

ACKNOWLEDGMENT

From a project engineer's report. Information supplied by Vincent E. Butler, vice president, Williams Brothers, Tulsa.

PART 2

Data Transmission Simplified



Photo, courtesy Rixon Electronics, Inc.

FIGURE 1—**What's new?** This equipment can handle 4800 bits per second—and that's pipelining so far as communications are concerned.

Here's a glossary of telemetering terms that will help you to understand the argot of automation

By F. Vinton Long
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FOLLOWING IS A GLOSSARY of terms which might help us. I am indebted for this, and part of my text, to Western Union's latest book on "Data Transmission" which came out in December 1960. I have deleted and in some cases expanded much of it, and have added some definitions from Lenkurt Electric in the glossary.

ALFA or ALPHA: A term used to indicate alphabetical characters as different from numerical.

BAUD: A technical term, originally used to express the capabilities of a telegraph transmission facility in terms of "modulation rate per unit of time . . ." For practical purposes, it is now used interchangeably with "Bits per Second," as the unit of measure of data flow. It was derived from the name Baudot, inventer of the Baudot Code. The singular and plural form of this word is the same. See BIT.

BAUDOT CODE: The standard five channel perforated paper tape code used internationally by the telegraph industry for about 100 years. Invented by Baudot of France, not to be confused with the popular movie actress. This code is often used in data processing equipment.

BINARY: A term for the system of mathematics which is based on the properties of the number 2, rather than the more common decimal system of mathematics which is based on the properties of the number 10. Binary mathematics can express any quantity in terms of the two digits, 1 and 0. It is widely used in data processing because manipulations involving only these two digits can be performed on much simpler equipment than would be required to manipulate the 10 digit decimal system of mathematics. The two digits, 1 and 0, are often programmed as "Yes" and "No," respectively.

BIT: A single pulse. The smallest unit of any binary digital code. The smallest particle of information that can be transmitted or handled in any way. Derived from the words Binary and digIT.

BLANK: Generally, a condition of "no information at all" in a given column of a punched card or in a given location in a perforated tape or on a typewriter. In the case of tape, the feed hole is perforated but no intelligence is perforated into the same vertical column. In some cases, however, processing equipment may be programmed to recognize a blank and perform certain functions, just as with any other function code.

CALCULATING: Computing a result by multiplication, division, addition or subtraction, or by a combination of these operations. A data processing function.

CARD COLUMN: One of twenty to ninety single digit columns in a tabulating card. When punched, a column contains only one digit, one letter, or one special code.

CARD FIELD: A number of adjacent card columns established as to number and position into which the same item of information is regularly punched.

CARD PUNCHING or KEY PUNCHING: The basic method for converting source data into punched cards. The operator reads the source document, and, by depressing keys, converts the information into punched holes.

CARD-TO-CARD: The operation of transferring data in punched card form at one location into data in the same form at another location, over a telegraph circuit.

CARD-TO-TAPE: The operation of conversion from the 12 unit Hollerith code of tab cards into a perforated tape code; usually into the five unit Baudot code.

CHANNELS: In perforated tape, channels are longitudinal rows, where intelligence holes may be punched, along the length of the tape. Also known as LEVELS or TRACKS.

CHANNELIZING: The process of subdividing wideband transmission facilities for the purpose of putting many different circuits requiring comparatively narrow bandwidths on a single wideband facility, such as voice grade or higher.

CHANNEL CAPACITY: The maximum possible information rate through a channel. Channel capacity is usually stated as the maximum number of bits per second that can be transmitted.

CHECK: A means of verification, as in error checking.

BUILT-IN CHECK: Any provision included within the data processing, storage, or transmission device for the purpose of verifying the accuracy of the information handled therein.

DUPLICATION CHECK: A check which requires that the results of two independent performances (either concurrently on duplicate equipment or at a later time on the same equipment) of the same operation to be identical.

TWIN CHECK: A continuous duplication check achieved on duplicate equipment.

MATHEMATICAL CHECK: A check making use of mathematical identities or other properties.

REDUNDANT CHECK: A check which uses extra characters, short of complete duplication, to help detect malfunctions or mistakes.

SUMMATION CHECK: A redundant check in which groups of digits are added, to produce a "nonsense total" which is also transmitted. The addition is repeated at the destination to ascertain accuracy.

PARITY CHECK: A summation in which the binary digits in a given block of data are added and the sum checked against a previously computed parity digit, i.e., a check which tests whether the number of pulses is odd or even.

CHECK CHARACTER: One or more characters carried in such a fashion that if a single error occurs (excluding compensation errors) a check will fail, and the error will be reported.

CLOCK: The primary source of synchronizing signals for a computer data system or data transmission system. In high speed systems, the "clock" may be

an oscillator, the output of which is used as a reference or timing frequency by the system.

CODE: Information composed of combinations of bits.

CODE ELEMENT: One of a set of parts of which "code characters" may be composed. Mark or space, dash or dot, are examples of code elements.

COMMON LANGUAGE: A code which is compatible with a multiplicity of various machines, such as the 5 channel Baudot code.

DETAIL PRINTING: A card-to-card copy operation. A data processing function for preparing documents from series of punched cards. Automatic addition, subtraction, cross-addition, or cross-subtraction may be combined in the same operation.

DUPLEX CIRCUIT: A telegraph circuit permitting simultaneous two-way operation.

DUPLICATING: The automatic copying (punching) of repetitive information from a master card or master tape into succeeding tapes or cards.

ENTROPY: Disorder, reduction from a good signal to a fuzzy one. An example of entropy is the gradual distortion and loss of a signal pulse as it travels down a long wire or cable.

FORM FEEDING OR FORM FEEDOUT: The rapid, accurate positioning of document forms on a teleprinter or business machine. This operation assures that data which is automatically entered on the form will fall into the proper blanks or areas.

FUNCTION CODES: Codes which appear in tape or cards to operate machine functions, such as carriage return, space, shift, skip, tabulate, etc.

HARD COPY: Printed out forms of data, as teleprinter copy.

HOLLERITH CODE: The standard 12 level code used by IBM tab cards.

IDP: Integrated Data Processing.

IDENTIFYING CODE: A code placed in perforated tape or punched cards to identify the contents therein, or their origin.

INTERFACE EQUIPMENT: Equipment common to two or more systems, for providing a compatible interconnection between them. In communications and data systems, may involve code, format, speed, or other changes as required.

LETTERS CODE: In the Baudot code, the function which causes machines to shift to lower case. This code is used to "rub out" errors in tape, as it is made up of an intelligence pulse in each of the five channels, and causes receiving machines to print nothing.

LEVELS: See CHANNELS.

LINE FEED CODE: A function code which causes page teleprinters or similar devices to rotate the platen up one line.

LINE FINDER: In data processing terminology, an electro-mechanical device attached to the platen of a printer which automatically line feeds it to a predetermined line on a printed form. Similar to VERTICAL TABULATION in telegraphic terminology.

MAKE-BREAK OPERATION: A type of telegraph circuit operation where the flow of current is interrupted as pulses are transmitted. (Also known as "DC" operation.) On long lines, frequency shift is to be preferred.

MARKING: The "idle" condition on a telegraph circuit where the circuit is closed but no bit is being transmitted. This condition exists between bits of the same character as well as between characters and when nothing at all is being transmitted. Conversely, the only time this condition does not exist is either when the circuit is open or while a bit is being transmitted. In other words, one might compare a "bit" as an open circuit condition.

MODEM: Modulator - demodulator, or channelizing equipment; used in carrier telegraphy or telephony and in data systems. Sometimes known as a subset.

NATIVE LANGUAGE: A code employed in certain machines which is generally not compatible with other machines. Opposite of "Common Language."

NON-PRINT; NON-PRINT CODE; NP CODE: The third case of a teleprinter, in which functions may be performed and signals passed through without printing or spacing taking place. The Non-Print Code (NP Code) is the function code which triggers this condition.

NON-REPRODUCING CODES: Codes which are punched into master tapes which cause functions to be performed but are not reproduced in the product tape.

NUMERIC: A term referring to data consisting of numbers as differentiated from alphabetical characters.

PAPER TAPE; PERFORATED TAPE; PUNCHED TAPE: Three synonymous terms referring to the encoded tape common to the telegraph and the data processing fields. 5, 6, 7, or 8 level codes are available, 5 the most common.

PARALLEL TRANSMISSION: A system of sending all bits of a particular character simultaneously.

PERFORATOR OR TAPE PUNCH: An off line keyboard operated device for punching code holes in paper tape.

PI CODES: Program Indicator Codes. When two or more programs are used in the same Program Tape, the use of P I codes permits automatic selection of programs and permits switching from one program to the other.

POLAR OPERATION: A type of circuit operation where the flow of current is reversed as pulses are transmitted. Polar differs from "make-break" operation in that, with polar operation, current always flows when the circuit is closed. Only the direction of current flow is reversed by transmission.

PROGRAM CARD: A pre-punched card which serves to instruct the machine in which it is used concerning the steps or operations it is to perform.

PROGRAM DRUM: A revolving cylinder on which the Program Card is mounted.

PROGRAM TAPE: A pre-punched tape which serves to instruct the machine in which it is used concerning the steps or operations it is to perform.

QUANTIZE: To convert a continuous variable, such as a waveform, into a series of levels or steps. There are no "in between" values in such a "quantized" waveform. All signals are represented by the nearest standard value.

REDUNDANCY: Added or repeated "information" employed to reduce ambiguity or "error" in a transmission of "information." As signal-to-noise ratio decreases, redundancy may be employed to prevent an increase in transmission errors.

REPERFORATOR: A device for receiving telegraphic signals and punching them into paper tape. Sometimes referred to as a TAPE PUNCH or PERFORATOR.

SERIAL TRANSMISSION: A system of transmitting bits of character in line sequence. Generally used in telegraphic operation.

SINGLE CIRCUIT: A telegraph circuit capable of non-simultaneous two-way communications. See DUPLEX CIRCUIT.

SKIP CODE: A functional code which instructs the machine to skip certain predetermined fields.

SORTING: The process of classifying items of data into groups according to any particular common characteristic. Sorting may also be done in numerical, alphabetical or other logical sequence. A data processing function.

SPACE CODE: Similar to SKIP CODE, but restricted to one space at a time.

STORED PROGRAM: May be a master tape or card held from day to day to be used with successive data tapes or cards. In computers, programs may be read in and held in storage or magnetic tape, magnetic drum, or magnetic core for future processing operations.

SUB-BAND: One-half of a V-F (Voice Frequency) band. Usually the upper or lower 1500 cycle portion.

TAPE-TO-CARD: The operation of conversion from a perforated tape code to a punched card code; usually into the Hollerith code.

TAPE PUNCH: See REPERFORATOR.

TAPE READER: See TRANSMITTER.

TERMINAL: A general term referring to the equipment at the end of a telegraph or radio circuit; Modems and associated equipment. Also used for voice operation.

THROW-AWAY CHARACTERS: When transmitting tape over a telegraph channel, certain function codes cause receiving equipment to perform functions which require more time than is allowed between successive characters in the transmission. Examples of these functions are form feedout, duplicating of card fields, etc. In order to prevent reception of an intelligence character while the machine is in the midst of performing such a function, a calculated number of "throw-away" characters must be inserted into the tape immediately following the function code and ahead of the next printing or function code. Letters codes are usually used as "throw-away" codes.

TRANSMITTER: A device for transforming perforations in a paper tape into telegraphic pulses for transmission. Also known as a TAPE READER.

TRIBUTARY CIRCUIT: A circuit which connects an individual drop or drops to a switching center.

TRUNK CIRCUIT: A circuit which connects two switching centers.

V-F BAND: A "Voice Frequency" Band. A transmission facility of approximately 3000 cycle bandwidth, capable of telephone quality communications.

WAY-OPERATED CIRCUIT: A circuit shared by three or more stations on a "party line" basis. One of the stations may be a switching center. May be single or duplex circuit.

WORD: In telegraph terminology, any six keystrokes. In business machine terminology, frequently any five keystrokes. In supervisory control, can also be an instruction or "function." In digital telemetering can be a value, such as pressure.

RAPID READING 1

How to Read Faster and Better

If you want to improve your efficiency on the job—if you want to read faster and understand more—then you'll be interested in this new three-part series. Here's your chance to take a rapid reading course free!

Nila B. Smith
The Reading Institute, New York University
New York City

TODAY, THERE is an entirely new reading methodology that has arisen to aid adults in meeting the demands of our times. This has been necessary because never before in our history has there been so much reading to do. Never before has there been so little time in which to do it.

Thousands of newspapers, hundreds of magazines, dozens of books roll from the press daily. Every man is confronted with mountains of memos, correspondence, reports, and he never quite clears them up until another avalanche descends upon him. Yet all of these items that require reading must be respected because these days to lead one *must* read. And we all aspire to leadership.

What is the answer? Not more time in which to read, but the ability to read more in the time we have. We need to develop a new reading tempo to gear in with the pace of the space age.

In order to meet this need which adults throughout the country are feeling a new art has arisen, a new art of reading which enables the reader to get more out of what he reads in a shorter time. The purpose of this article and the one that follows in the next issue is to acquaint you with some of the newer techniques, and to tell you how you can apply them in your own reading whether it be for business or for pleasure.

SOME GENERAL POINTERS

First of all it will be heartening for you to know that it is easy for an adult to improve his reading ability. The reading skills yield readily to the right treatment and practice. I have come in contact with the records of hundreds of people who have taken a course in reading improvement. Their gains are surprising and gratifying.

Even though improvement comes readily, you need to realize that reading is a composite made up of dozens of different skills. You can't expect to make much in the way of gains if you approach reading ability as a "lump sum." You need to concentrate on one ability at a time until you are pretty good at using it, then gradually combine abilities in different ways as they serve your purposes.

Practice Is Necessary. Furthermore, you must realize that there is no trick or magic about learning to read faster and better. Reading makes use of skills just as piano-playing or skating or golf depend upon the use of skills. Instruction and practice are basic essentials in any skill development program. When you begin to play golf an instructor tells you what the different clubs are for and shows you how to make the strokes. Highly developed ability, however, comes only through continuous practice in using the clubs and making the strokes in the right way.

So it is with reading skills. In these three articles you will learn the use of some of the different "clubs" and how to "make the strokes." But it's up to *you* to do the practicing. As a reader of technical and semi-technical material in connection with the pipe line industry you must resolve to tackle your reading improvement program in the same way you would tackle skill

development in any other area. Desire, determination, instruction, practice—these are the basic ingredients in your recipe for reading improvement. Once you've put yourself in the right frame of mind, you've made a good start.

With these general considerations in mind, we shall now discuss some of the specific reading skills and suggest "Do it yourself" techniques for you to use in streamlining your own reading ability.

INCREASING SPEED

Your first interest probably is to learn to read more rapidly. Here are some of the "secrets" of speed reading.

1. Set a Purpose. In increasing your speed, and in fact in developing all of the other skills discussed in this article, decide upon your purpose for reading a selection *before* you start to read it. Is it to get information that would be helpful in your work? To find out about new equipment which might make a contribution to your work? To gather news about what others are doing? To find out how to improve your personal efficiency? To be entertained by some light reading? To follow the plot of a story? Or what?

Phrase your purpose concisely, and keep it uppermost in your mind throughout the reading of the entire selection. A well defined purpose pulls your eyes along more rapidly, and it gives you something to tie to in selecting and organizing ideas gathered from the text. In fact your purpose is the pilot which guides you over the sea of print and leaves you with a well-filled dragnet of ideas at the end of your reading journey.

2. Grasp Groups Of Words. Investigations of eye-movements have shown that the rapid reader's eyes move fleetingly across the lines, pausing briefly two or three times on each line, picking up an "eyeful" of words at each pause, while the eyes of the poor reader pause on every word or on small word units. It is the mind, of course, that controls the eye-movements. The great value of eye-movement investigations is that they furnish us a picture of the different ways in which the mind works in perceiving reading symbols. They tell us that the mind of the poor reader loafs along, picking up very small units at a time, while the eyes of the excellent reader race over the lines, gathering an entire, meaningful idea at a glance.

Cultivating the habit of reading for *ideas* not only increases speed, but it also increases understanding. A person who reads one word at a time thinks in terms of the meanings of these separate words and thus he "can't see the woods for the trees." The synthesis of important meanings is lost in any meticulous perception of the meanings of separate words or small units.

The first and most important instruction is, "Read for Ideas!" If you can cultivate the habit of rapidly picking up one complete thought unit after another, the eye movements will take care of themselves.

Try grasping fairly long groups of words, each of which presents a complete idea, in reading the rest of this article; then in all of the reading that you do.

3. Force Speed. Perhaps you've fallen into the habit of reading in a slow tempo. Maybe you developed a rate that was comfortable for you while you were in the elementary grades and have done nothing about changing it all through your life. You **can** change it though. You have a comfortable, habitual rate of walking but you **can** walk faster when you want to. So you can read faster if you try. Shake yourself out of the old lethargy. Force your speed: make yourself read faster—faster than you ever have read before. Consciously push your eyes across the lines as fast as you can make them go and still know what you are reading about. Across, back, across, back, across, back, in rapid rhythmic sweeps. Just make those eyes leap over the lines. They are your servants. You can control them. Don't let them loaf along in the old lazy way.

Forcing yourself to read faster will take effort at first. It won't be as comfortable as the old rate. But after a time you will become accustomed to the rapid tempo, and new patterns of rate will become firmly established. You will then read fast unconsciously and just as a matter of habit.

4. Application. Now you have some information on how to increase your speed. But information alone won't do the job. You will need to practice, practice, practice. Set aside stated periods of time for practice—perhaps half-an-hour each evening. Choose easy selections while you are breaking the old tempo. Set an alarm clock to go off three minutes hence. Force your speed in taking in long, meaningful groups of words. Stop when the alarm rings. Count the number of words you have read. Divide by 3 and that will give you your W.P.M. (words per minute) score.

Check your understanding, also. Speed without comprehension is useless. After each trial, get someone to question you on the content of what you have read; or try to tell yourself the gist of the selection, and check your accuracy by referring to the text, itself.

In addition to the specific periods in which you work on speed, force yourself to read faster everything that you have to read all day. Try the same techniques described in this article on *everything* you read. Regardless of whether you are reading memos or ads that are piled up on your desk, news items, magazine articles or chapters in books, push your eyes along as fast as you can make them go, grasping large groups of words, and accelerating your mental process in rapidly picking up meanings.

PREVIEWING

An exceedingly useful technique to the man in industry or business is that of *previewing* a selection before reading it.

There is a basic reason why we "window shop" before buying a garment or a car or a new gadget. We want to "size up" certain characteristics of articles in which we are interested as a whole. If it's a coat, we first evaluate it in terms of material and color. Then we look at the style of the garment, and note the cut of the collar and the flare of the cuffs. No doubt, we compare this piece of merchandise with others in price. In short, we gather as much information as possible about characteristics which are important to us before we actually buy. Likewise, it is possible and advisable to glean as much information as we can about an article, a chapter or a book before we read it.

In some cases the preview will provide you with all the information that you desire and you won't find it necessary to read the selection at all. In other cases the preview will "whet your appetite," increase your interest and strengthen your personal motive for reading. In these latter cases when you actually do begin to read the selection, you will find that your pre-

reading insight has paved the way for speedier and more comprehensive coverage of the printed page.

Here are some techniques to use in previewing your reading matter.

1. Study the Title. The first step to take always is to study the title. The title holds a world of information for you. It tells you concisely what the selection is about. It gives you a quick cue as to the topic of discussion. It may be a deciding factor in determining whether or not you want to read the selection. If you decide that you do want to read, then you have advance information in regard to the subject discussed and can read in terms of the promise that the title holds out to you.

As an example of this technique, consider the title of this article, "How to Read Faster and Better." In examining this title you know before you read the article that its subject is *reading*. You know that it it will tell you something about speed in reading. Of course, you may be a fast reader now, but you may be interested in the promise of learning to read "faster, better."

In longer titles there usually is one key word that gives you a clue in regard to the precise aspect of the subject discussed. Consider some titles from previous issues of PIPE LINE INDUSTRY. One title was "When Engine Foundations Are in Sandy Soil. The title shows the article is not about engine foundations in general, nor about soil conditions in general. The key word is "when." The article promises to tell you what to expect "when" engines foundations are in sandy soil.

Another title: "Freeze Stresses in Piping for Better Analysis." In studying this title you are not led to believe you are going to read about piping stresses in general. You are given a key word that sharpens the general topic, confining it to one aspect of piping stresses. That key word is "analysis."

In studying any title think about the general topic but also find the key word which gives you a clue in regard to the specific nature of the discussion.

2. Examine Visual Aids. If any visual aids are furnished, next turn your attention to them, and study these visual aids for their meaning significance. Illustrations may accompany the selection. If so, look at them carefully. They will aid your comprehension by giving you a vivid mental picture of the people, things and locale dealt with in the context. If maps are provided, study them. Your reading will be more meaningful if you have precise geographical locations in mind. Often graphs and charts are provided. If so, study these carefully before you read the article. They will give you a quick grasp of relationships and proportions amongst data which will be discussed in the text.

Men working in the pipe line industry frequently encounter charts and diagrams in their reading. PIPE LINE INDUSTRY, for instance, always contains many drawings carefully labeled each accompanied with a clear explanation. In reading this magazine or any material in which charts, graphs, flow diagrams, etc., appear, study all of them *before* you read. Then when you do read, you will have a much clearer understanding of the processes which the drawings try to visualize for you.

3. Glance at the Subheads. Next, glance through the selection to see if subheads are used. If so, you will find that a quick survey of these subheadings will be very valuable to you. You should consider each one for the information which it actually gives or which it implies. These subheads are the major topics in the author's outline. They reveal to you the heads of discourse in the structure of the article as a whole.

As an example of the use of this technique, glance at the boldface subheads up to this point in this article. Did not this glance at subheads alone tell you what topics would be treated? Furthermore, did not the numbered subheads under "increasing speed" tell you what techniques to use in accomplishing this skill? In other words you could have gotten the gist of this article up to this point, simply by studying the title and glacing at the subheads.

There will be many occasions in which a preview of subtitles will tell you all you want to know. At other times they will serve as interest-leads to reading the different sections, and as door-openers to better understanding of the text that follows.

4. Notice Paragraph Length. As another step, examine the length of the paragraphs. Turn the pages quickly and find out if most of the paragraphs are short, medium or long. Remember, each paragraph is a thought unit. One idea is developed in each one of them. If there are many short paragraphs this is fairly reliable indication that the article will not be heavy with detailed ideas. On the other hand, if the paragraphs are long then there will be fewer main ideas, but each main idea will be expanded by numerous details. So, on the whole, this will be more difficult reading.

Finally, after you have done all of these things, make an estimate of how long it will take you to read the article. Count the words in a few lines to find the average number of words per line. Then multiply this number by the number of lines in the article. Once you have estimated the total number of words in the article, decide how long it should take you to read it. Don't be easy with yourself. Set as short a time limit as you think you can possibly meet. Then live up to it!

CRACKING THE PARAGRAPH

Can you "crack" the paragraph quickly and accurately? In other words can you break through the outer shell of a paragraph and get to the "kernel" at once? This is an extremely valuable skill and one that is subject to almost unlimited development. It is especially useful when working with paragraphs containing long sentences and dense with ideas. Such paragraphs make for difficult reading unless you know how to tackle them. If you can immediately locate the "heart" of a long, detailed paragraph, the supporting ideas seem to fall in line quite easily and naturally.

When you toss a pebble into a pool of water, you immediately perceive a circular ripple at the spot where the pebble came into contact with the water. Then other concentric circles appear, one after the other until there is an entire set of circular ripples. So it is with a paragraph. Figuratively speaking, the author tosses one main idea into a paragraph which sets all the other ideas in motion. It is your job to learn how to find this pivotal idea, swiftly and surely.

Main Idea Technique. In much of the reading that you do you won't care to take time to consider all of

the details. You will be satisfied if you can speedily glean the main ideas in the selection. Expertness in "spotting" the basic thought in each paragraph is the skill that you need to cultivate.

On the other hand, some selections will be of such significance, that you will want to read and consider the minor ideas carefully. Then you will find that locating the main idea in each paragraph is of major importance because the central thought provides you with a core around which you can organize the details. Whether you are doing cursory reading for the purpose of gathering the larger ideas, or whether you are doing detailed reading for exact information, you will find it to your advantage to acquire the technique of reading paragraphs. In order to do this, however, you must develop a systematic approach rather than just following along one sentence after the other without effort or thought in regard to paragraph organization.

Position and Wording Vary. The position of the key sentence in a paragraph varies. Often the germ idea appears in the first sentence. If so, this is a convenience to the reader because he doesn't have to search through the entire paragraph for the central thought. At other times, the important idea occurs in the middle, at the end, or somewhere else in the paragraph. Because of the variance in the location of the key sentence within a paragraph, position is not a reliable guide in finding the main idea. You must learn surer ways of locating the one basic thought.

Furthermore, the main idea may appear as a complete sentence in itself, or in a few words within a sentence which may express the basic thought. Quickly finding and grasping the main idea regardless of where or how it appears is one of the fine arts of reading.

Finding Main Ideas. The first thing to do is to develop a new attitude toward paragraph reading—the attitude of thinking of each paragraph as a unit. As you encounter a new paragraph, view it as if it were all the reading material you had before you at the moment. Decide what is the one important idea this paragraph has to impart.

Application to Daily Reading. You have been given some basic instruction in the art of reading paragraphs. You have been launched on the technique of finding the main idea accurately and quickly. The extent to which you perfect this skill depends on you. You may sharpen this tool to a very fine point by continuing to use it every time you have occasion to read. Special practice periods are of course highly desirable as well.

From this time on, in all your reading, both informal and special practice, do three things:

1. Force your speed
2. Take a preview
3. Apply paragraph-reading techniques.

Keep a record of your speed and comprehension in each of your practice periods. You should begin to note substantial gains.

About the Author

Dr. Nila Banton Smith is professor of education at New York University where she is director of the reading institute and head of the graduate teacher training programs in remedial reading. She is recognized as one of the leading reading authorities in the country, having authored 16 textbooks, one trade book and more than 200 magazine articles on that subject. A native of Michigan, Dr. Smith received her B.A. degree from the University of Chicago, and her M.A. and Ph.D. degrees from Columbia University. Previous to joining NYU, Dr. Smith was teacher and supervisor of reading in the Detroit public schools, associate professor at Indiana University and professor at the University of Southern California. She is a member of numerous professional societies, and rates her reading speed at about 1,200 words a minute.

Jay Curts of PLI Advertising Staff Dies

Jay Curts, 56, Gulf Publishing Company and PIPE LINE INDUSTRY advertising representative on the West Coast for nearly 25 years, died at his home in Pasadena, Calif., October 11 after a long illness.

Jay Curts

In his long association with Gulf Publishing Company, Curts became a well known figure in oil industry circles on the West Coast and throughout the United States.

"Those who knew Jay Curts before his illness remember him for his sunny, bubbling spirit," said GPC President William G. Dudley, "and those who became acquainted with him after he was stricken categorize him in the same manner." The seriousness of his illness never dimmed his spirits.

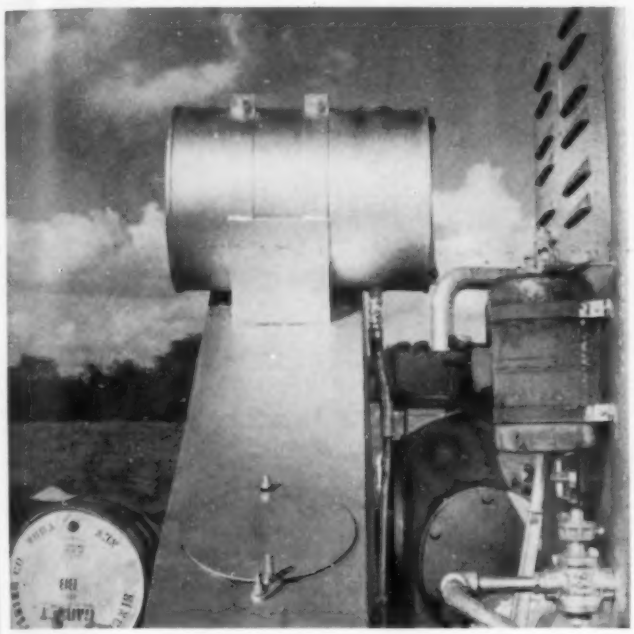
Curts was born February 26, 1905, in Cincinnati, Ohio, and moved to California at an early age with his family. After graduation from the University of California, he joined the advertising staff of the *Dallas (Texas) Dispatch*. He was advertising manager of the *Dispatch* when the late Ray L. Dudley, founder of Gulf Publishing Company, hired him in 1937 as GPC's West Coast representative.

Survivors include his widow, Mrs. Myrtle Curts, and one daughter, Mrs. Lloyd Christy. Funeral services were held in Pasadena with burial in Dallas, Texas.

How to do it

PIPE LINE HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, PIPE LINE INDUSTRY, P. O. Box 2608, Houston 1, Texas



Lubricate Vital Parts From Drum on Drive Guard

Mount a small oil drum on the flywheel and drive guard on an engine-compressor unit, and provide an easy means of lubricating vital engine parts.

As shown here, the oil drum is permanently mounted on the guard; it has a gage glass, and bottom connection which leads to points requiring frequent lubrication. Rubber hose is used between the tubing attached to the engine and the tubing attached to the guard to prevent failure through fatigue. The cock at the bottom of the drum is adjusted to provide a small drip as needed.

Be a Shutter Bug Today And Save Money Tomorrow

Building a new cone roof tank? Grab the Brownie or Land camera and make a few snapshots of the inside and other hard to get at places. Then file the photos and the negatives. Some day when trouble arises or modifications are planned, the photographs may be worth many times their weight in gold.

Pipe line companies are using photography more and more for engineering purposes. A number of gas companies are using them to aid draftsmen in preparing "As Built" drawings. Another company is using photographs in place of some of its engineering drawings.

But in maintenance the photographs will pay off, too. Take photographs of the reinforcing steel in a foundation before the concrete is poured, or of intricate underground piping arrangements, and some day you may find that you have saved your company a considerable sum of money.

Expanded Metal Guard Protects Tractor Operator

When clearing and grading right of way through tall timber, the best safety measure is to install a guard above tractor operators saddled with the task of toppling the trees. Sometimes, the backlash of the falling tree can dislodge dead limbs, which can otherwise crash down on the tractor operator.

The cost of the guard is small. It can be made of pipe frame—2⅞-inch O.D. oilfield tubing is excellent—and the heavy expanded metal or hardware cloth. It should be made to bolt onto the tractor and the front part should be open to provide maximum visibility.

Anchor Field Compressor To Diminish Stresses

Many field compressor units are simply unloaded onto skids, piped up and left to operate. But this practice can bring trouble. For as the unit operates it vibrates, and this can lead to turning and settling. As a result, severe stresses can be imposed on the high pressure piping.

Shown here is one simple method of keeping the unit in line. With dead men fore and aft of the skid and connected with turnbuckles, the unit simply can't twist. Note the spike between the blades of the turnbuckle; this keeps vibration from backing off the turnbuckle.

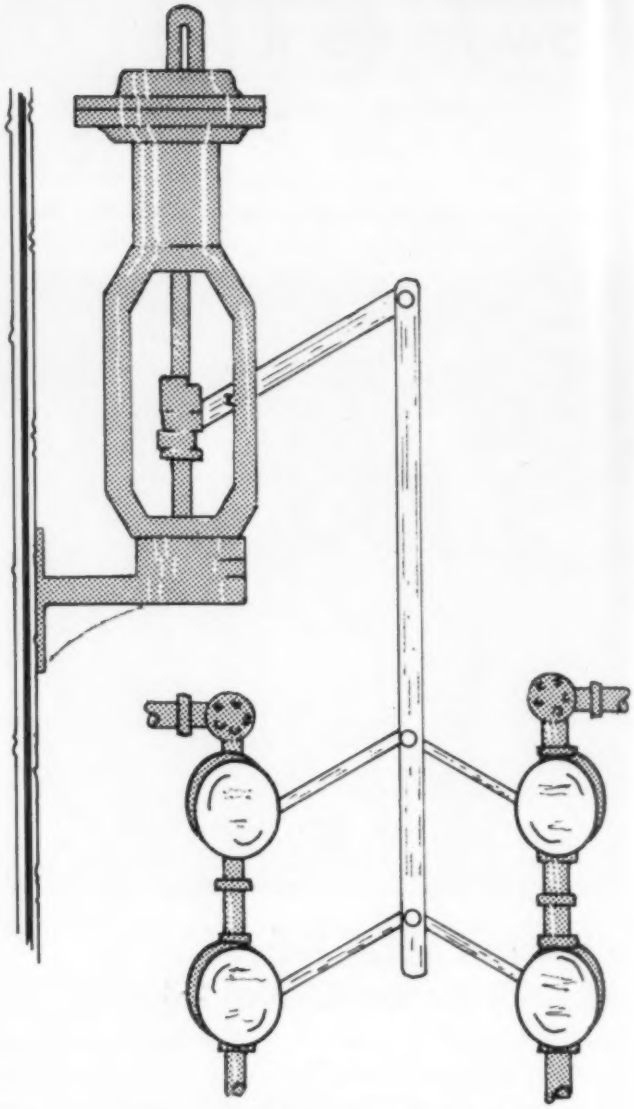
The dead men can be made of pipe, creosoted timber or conventional mud anchors.

Pour Concrete Foundations So They Can Be Salvaged

One of the big advantages of packaged compressor units is that they are about 90 percent salvageable. Why not make this figure higher. For instance, why not salvage the concrete foundation (if one is used) along with the rest of the installation.

By forming the concrete carefully—leveling the soil before making the pour and forming the sides with plywood—the foundation can be used at other locations. Also, along with anchor bolts, include four eyes—one at each corner—for slings.

To move the foundation to a new location, first level the site, and spread about two inches of sand over the soil. This will let the foundation "seat" at its new location.



Upper Part of Control Valve Actuates Ignition Switches

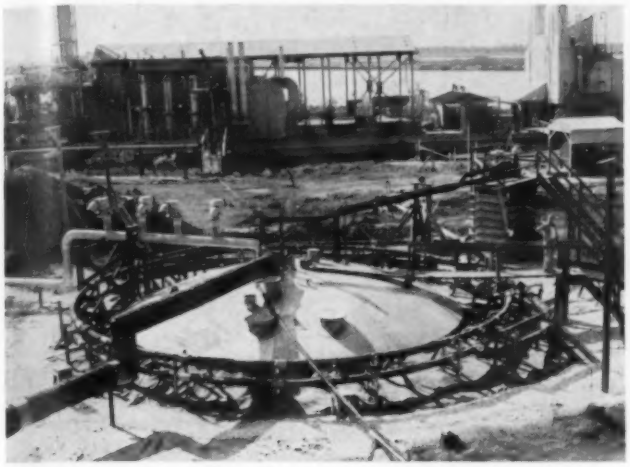
Here's a versatile control method which has many applications. The upper part of a control valve—including the diaphragm, stem, etc., but not the body and plug—is used to actuate mercury switches through a linkage as shown.

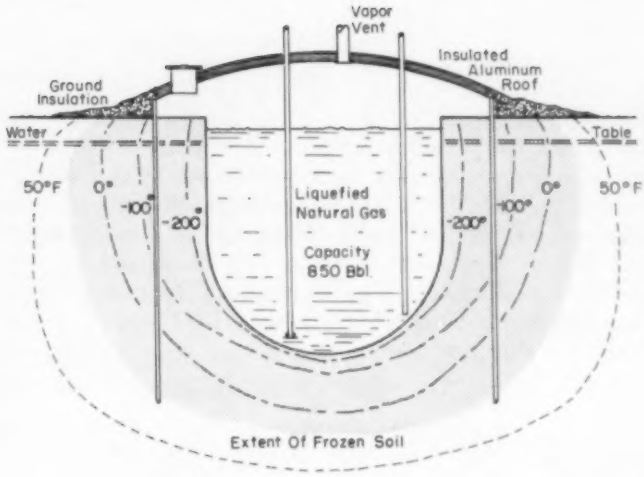
In this instance, Transcontinental Gas Pipe Line Corporation uses this arrangement to ground out the ignition of four engines at one station when the emergency shutdown system is actuated. The ½-inch line to the top of the diaphragm runs from the high-pressure emergency shutdown system which normally "holds" the station on the line. When one of the trips on the shutdown system is thrown, the pressure is exhausted, causing valves to close, open as necessary to take the station out of service. When this low pressure reaches the diaphragm of this control valve, the spring-loaded stem rises and through the linkage shown, the four switches are thrown, grounding the ignition of each individual engine.

Such a control system has many applications. It could be used for almost any "On" or "Off" function.

Ideas for the Future

By **Donald M. Taylor,** Engineering Editor





Store liquefied natural gas in a frozen hole in the ground

Dig a hole in the ground, freeze the earth around it, add an insulated cover and you will have a highly satisfactory "tank" for storing liquefied natural gas. What's more, the super-chilled liquid can be economically maintained at its minus 258° F temperature at atmospheric pressure.

Seemingly this was the conclusion reached by the majority of the 50 or so gas industry executives who witnessed a demonstration of the new idea for gas storage by the two firms which developed it. They were particularly impressed by the apparent economy and safety of the 850-Bbl. "frozen earth" tanks which Conch International Methane, Ltd. and Constock-Pritchard Liquefication Corp. displayed at a site southeast of Lake Charles, La. on October 12th.

This is a completely new concept in underground storage of low-temperature methane. The process involves freezing the ground surrounding the area to be excavated, excavating the hole and then installing a vapor-tight, sealed aluminum roof over the hole before filling it with liquid gas.

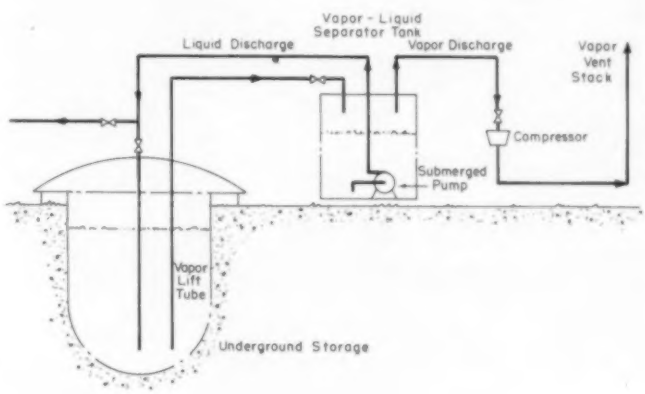
At the Lake Charles test site, the ground was prefrozen by circulating refrigerant through pipes spaced around a 28-ft diameter circle and buried 30 feet deep. The purpose was to prevent caving of the soil during excavation and to minimize the loss of natural gas during filling. When the frost boundary moved inward four feet to the cavity-wall radius, excavation was started.

The hole was dug 20 feet deep with a 20-ft diameter cavity. The soil consisted of layers of silt, sand, sandy clay and clay. The water level was 2.6 feet below the surface. Thermocouples were installed prior to freezing to enable engineers to maintain a check on the state of the walls of the underground tank. After excavation was complete, a thermally insulated circular aluminum roof was lowered over the hole and sealed to the earth by a special method.

Prior to filling with the sub-zero liquid, the frozen earthen walls were sprayed with liquefied gas. This was to minimize thermal shock which could have caused fracturing.

Three weeks after filling, the temperatures of the surrounding soil were as shown in the accompanying drawing. Note that the effect of latent heat in the soil water is reflected in the gap between 0° F isotherm and the 50° F isotherm which is larger than the gap between 0° F and —100° F.

So far no cracks have developed in the frozen soil and no liquid losses have been observed. Of course, there is a constant boil-off of the low temperature liquid, but this has decreased with time. It now runs about four



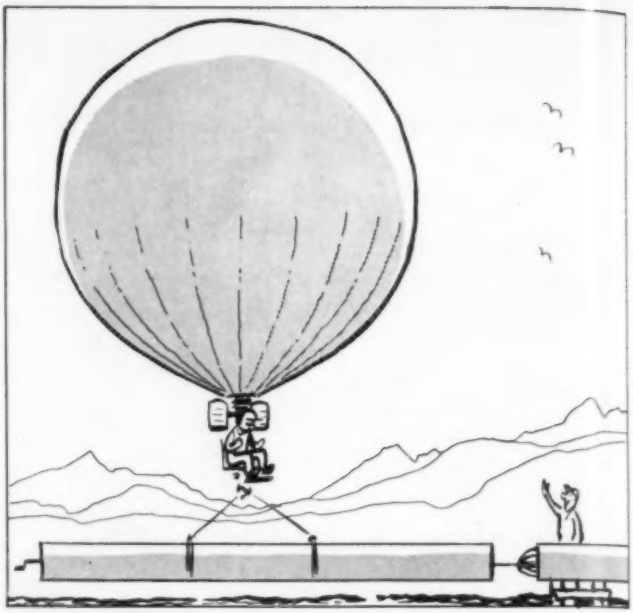
percent per day of the volume in storage. This is within economic limits because the boil-off can always be used as fuel or recompressed and recycled to the liquefaction plant, or sent to the pipe line for sale.

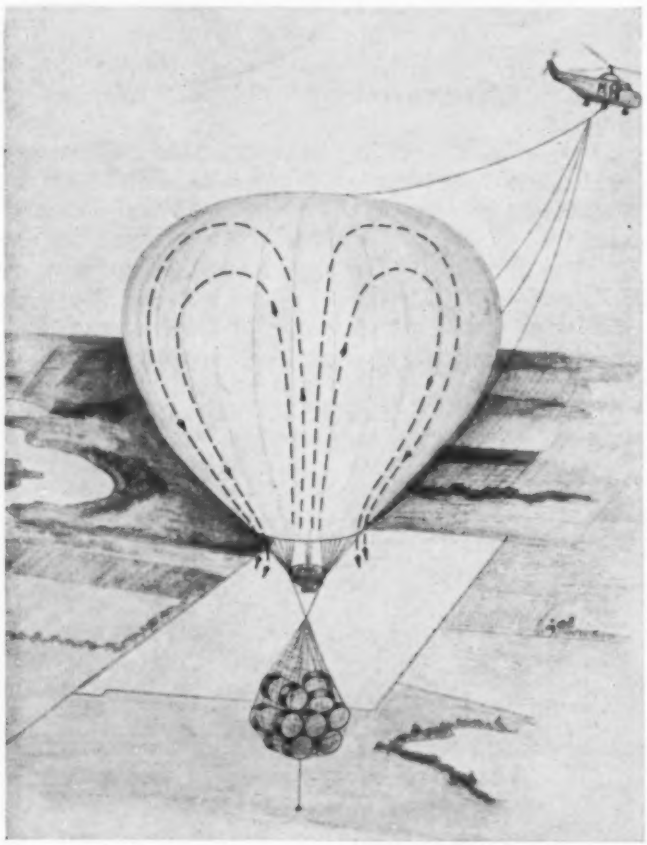
Pumping a boiling liquid creates special problems. But Conch which has shipped liquefied natural gas from Lake Charles to England via the famed USS "Methane Pioneer" has had considerable experience in this regard. The company chose the Vapor Lift method of pumping which is illustrated in the accompanying drawing. Here's the way it works. The compressor suction causes vapor and liquid to flow from the underground storage to the secondary tank, where the liquid has sufficient NPSH to be

picked up by a pump. The vapor is compressed, and it may be heat exchanged with the sub-cooled liquid as the latter is discharged from the pump. The condensed vapor is then fed back into the system.

Credit for development of this revolutionary idea goes to Dr. C. M. Sliepcevich, consulting chemical engineer of the University of Oklahoma.

Conch, which is owned by Continental Oil Co., Canadian Shell and Union Stock Yard and Transit Co. of Chicago, pioneered research in the liquefied natural gas field, and conducted more than five years research in transporting natural gas in liquefied form at a temperature of minus 258° F. This firm built an experimental liquefaction plant at Lake Charles in 1957 and joined the British Gas Council in a project to ship liquid methane to England. The first shipment of liquid gas in the "Methane Pioneer" was made in February 1959. Then the ship made seven more round trips to London, proving the project technically and economically sound.





"Where do you work?" "On a pipe line." "What do you do?" "I'm a balloon operator!"

Don't dismiss the idea of having *balloon* operators on pipe line spreads as being so much "hot air" too quickly.

For hot air balloons—similar in most respects to those which first lifted men off the earth back in the late 1700's—are making a strong comeback. And at least one manufacturer has an eye cocked toward the pipe line market!

Raven Industries Inc., of Sioux Falls, S.D., has developed hot air balloons for sportsmen and military use which are turning in amazing performances. Not long ago, for instance, a compact package containing one of the balloons was dumped from an airplane at 12,000 feet. A small drogue chute opened at once, removed the container and positioned the falling balloon upright.

As the balloon fell, a blast of air partially inflated it, and a time clock turned on and ignited the propane burners. At 9,000 feet, the balloon ceased falling and ascended to 15,000 feet almost as quick as you can say "Jules Verne."

To explore the matter of hot air balloons, PIPE LINE INDUSTRY recently interviewed Don Piccard—one of America's foremost balloonists and manager of Raven's thermal balloon program. Piccard, incidentally, holds some four altitude records; his father is the famed balloonist Jean Piccard and his mother soared higher than any woman in the world on October 23, 1934 when she reached 57,000 feet.

On the subject of thermal balloons, Piccard fairly bubbles with enthusiasm. "Just the other day," he said. "I decided to take one up. It took less than 15 minutes to inflate a balloon and get it off the ground!"

"It's a great feeling to fly one, and the response to the burner controls is almost unbelievable!"

When asked about the possibilities of using balloons to string or handle pipe, Piccard said, "There are limitations today of course. A 40-ft diameter balloon, for example, has a pay load of only 240 pounds. But get up into larger sizes, and you can improve efficiencies and increase payloads, too. A balloon with a 6 MMcf displacement will lift about 85,000 pounds. Its fuel consumption will run about 100 gallons of propane an hour.

"However, this brings up another problem. A balloon of such gigantic proportion would develop about 32,000 pounds wind load in a 20 mph wind."

But who knows? Perhaps a medium sized balloon—say about 80 feet in diameter—which could lift about 4000 pounds could prove useful to pipeliners. After all, pipeliners are highly imaginative, and they just might decide to try a balloon on a leash as a pipe line tool. S

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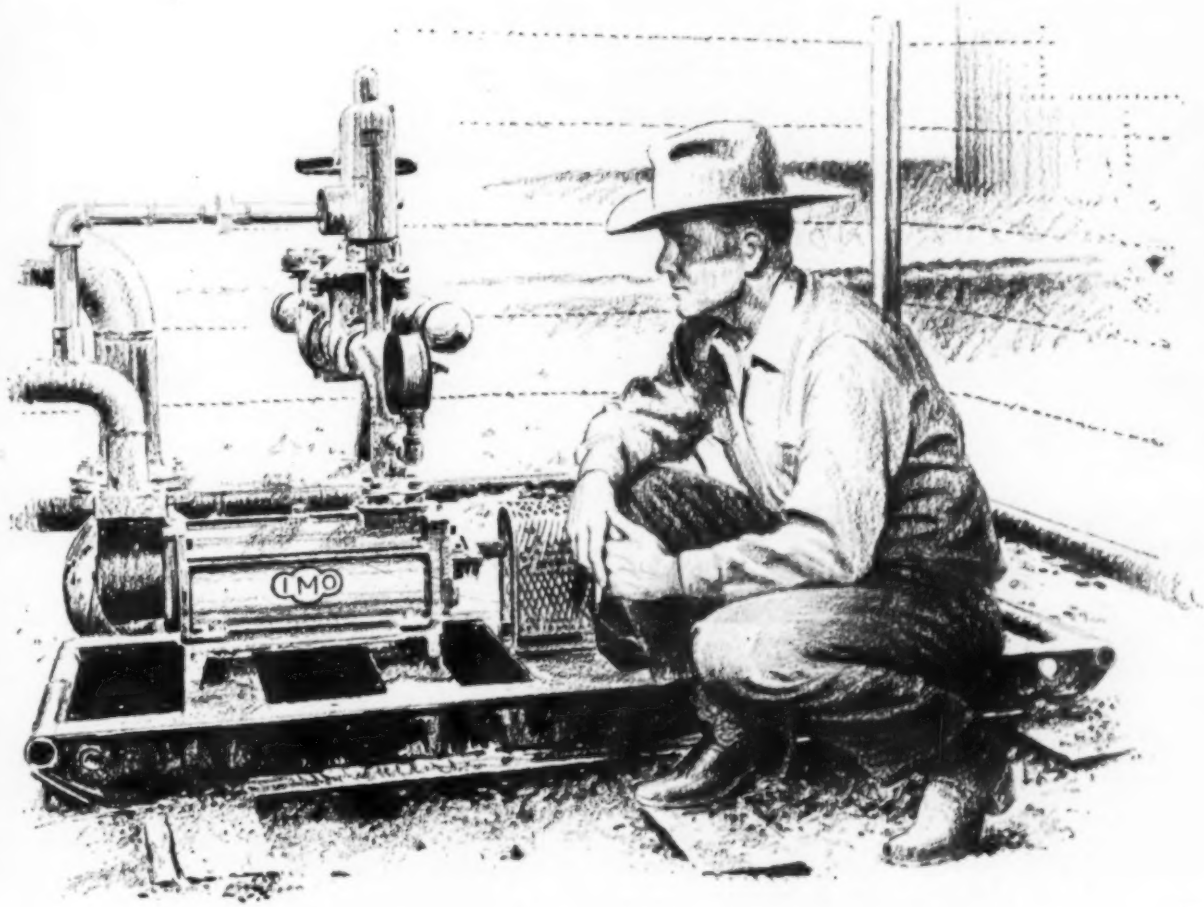
In thousands of applications, pumping crude oil and other petroleum products, the De Laval IMO pump is giving outstanding service. It can bring the same advantages to your installation. For application and performance data, selection information, dimension drawings and tables, write for Bulletin IM-3200.

De Laval Steam Turbine Company, Trenton 2, N. J.



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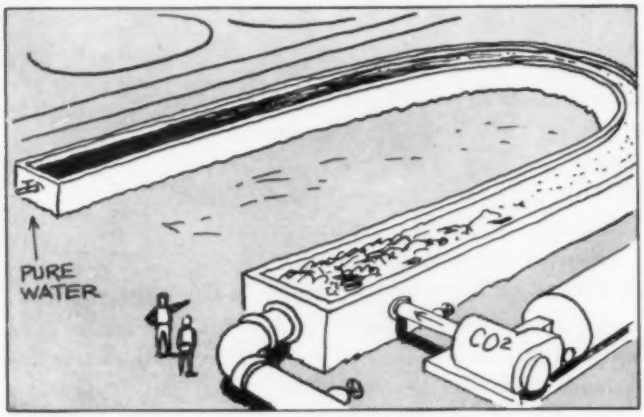
MARINE PROPULSION AND AUXILIARY EQUIPMENT • HELICAL AND EPICYCLIC GEARS • TURBOCHARGERS

don't be surprised some day when you meet a balloon operator on a pipe line spread!



Re-using sewage water!

Water doesn't wear out; it can (and is) used over and over again.

To short circuit nature's method of reclamation, Los Angeles, chronically short on the wet stuff, is experimenting with a process which may make it possible to re-use sewage water.

If successful, the experiments will pave the way for the city to recover a large portion of the 280 million gallons of water it wastes each day!

The new process is based on growing algae downstream from a conventional oxidation and sedimentation sewage treating plant. The developer of the idea is U.C.L.A. professor, Albert Bush, who estimates that the new process will add only 10 to 15 percent to the normal cost of sewage treatment. He bases his estimate on results obtained with a 100 gallon per day pilot plant.

Here's the way the process works: The effluent from the plant will be piped into a large U-shaped pond; and to encourage the growth of the small green plants, carbon dioxide will be added to the water. The source of the CO_2 is burning methane which is produced in the primary steps in the conventional sewage plant.

This process sharply reduces the concentration of inorganic ions such as calcium, magnesium, sulphate, bicarbonate, etc. However, it does not remove the biggest bugaboo of sewage plant designers—the synthetic detergents used for washing dishes and clothes.

Water jets used in study of erosion in turbine blades

Researchers at Westinghouse Electric Corp. are experimenting with the erosion of turbine blades caused when water droplets encounter the blades as they whirl at near supersonic speeds. The company devised a means of producing a 3400 mph stream of water by firing a lead pellet into a small sealed reservoir with compressed air. The jet of water then strikes the test metal. So far stellite (a cobalt alloy) and tungsten carbide have shown the greatest resistance to erosion.

Rules of Thumb

and Engineering Data Sheets for the Pipeliner's field notebook

$25 for Engineering Data Sheet $15 for Rule of Thumb

These practical aids give quick, reasonably accurate answers to design, maintenance and cost estimating problems. PIPE LINE INDUSTRY will pay $25 for each chart, nomograph or data sheet published—$15 for each Rule of Thumb. Send your ideas to PIPE LINE INDUSTRY, P. O. Box 2608, Houston, Texas

Miscellaneous

—47—Find the advantages of block and tackle, taking into account the *pull out friction.*

The efficiency of various sheaves differs. For one with roller bearings the efficiency has been estimated at 96.2 percent. For plain bearing sheaves a commonly used figure is 91.7 percent. The following formula will give close results.

$$MA = \frac{W}{w} = E\,\frac{1 - E^{n}}{1 - E}$$

Where W = Total weight to be lifted by the assembly
w = Maximum line pull at the hoist
^{n} = Number of working parts in the tackle
E = Efficiency of individual sheaves
MA = Mechanical Advantage

It is assumed that the line leaving the upper block goes directly to the hoist without additional direction change (requiring a snatch block).

Example: Find the Mechanical Advantage of a 4-part block and tackle using upper and lower blocks having journal bearings, which have an efficiency of 91.7%.

$$MA = .917\,\frac{1 - .917^{4}}{1 - .917} = .917\left(\frac{1 - .707}{1 - .917}\right) = .917\left(\frac{.293}{.083}\right)$$

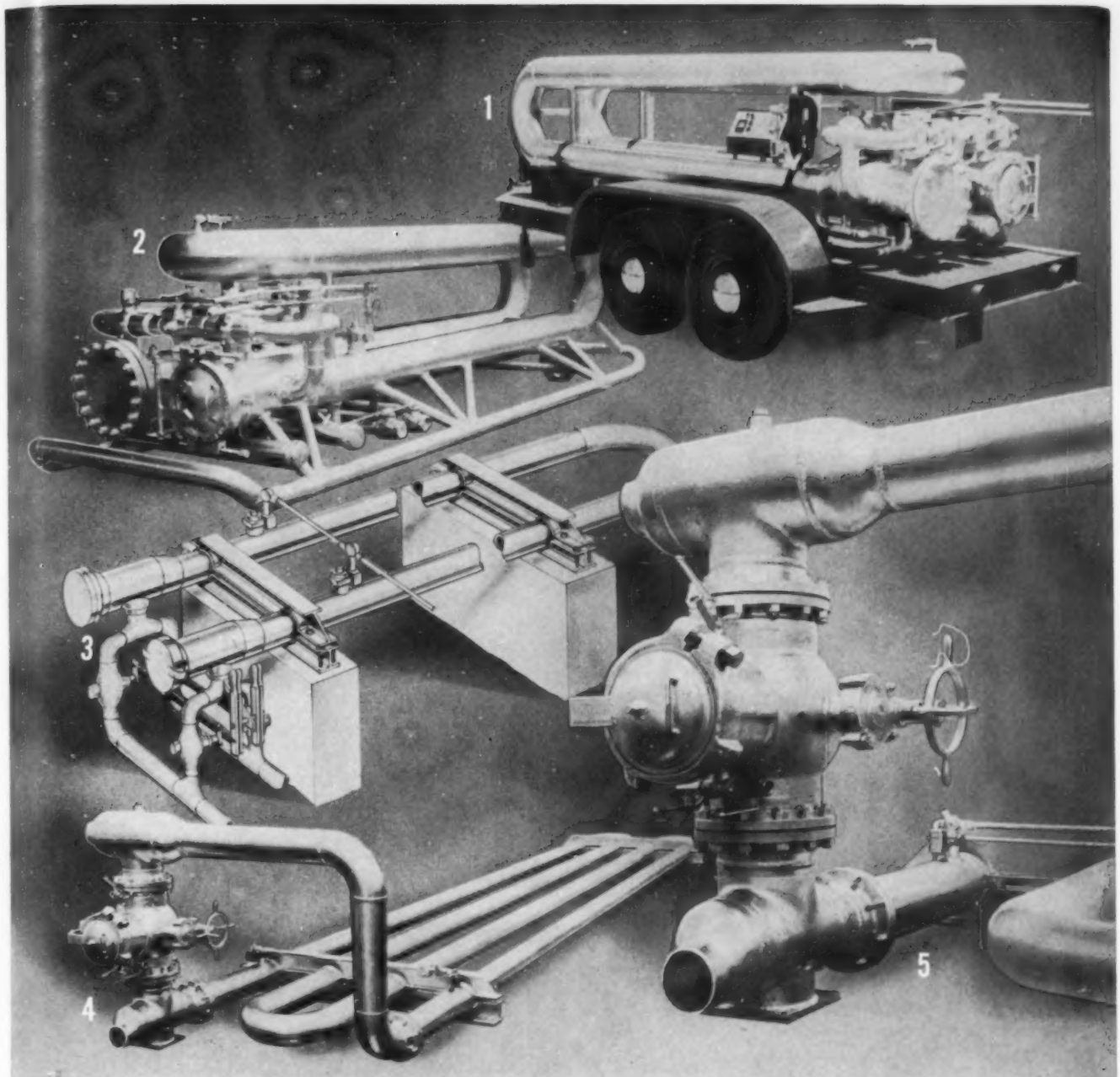
$$MA = 3.25$$

If the load weighed 3,250 pounds, what pull would be required on the lead line?

$$\frac{W}{w} = MA$$

$$\frac{3250}{w} = 3.25$$

$$w = 1000 \text{ pounds.}$$



NOW ACCURATE, DEPENDABLE METER PROVING — Maloney's **new** precision built provers now make perfected meter proving practical on virtually all liquid-carrying lines. Constructed of high quality materials, Maloney unidirectional and bi-directional provers are fabricated under constant engineering supervision. Illustrated units are:

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2. **Bi-directional skid-mounted**
3. **Bi-directional U-Bend**
4. **Unidirectional, interchange and loop**
5. **Unidirectional, interchange only**

The units illustrated are standard models. However, larger units may be specially engineered to fit a customer's particular need. For additional information on all Maloney meter provers, please write the Company's Houston office for Bulletins MP-1 and MP-2.

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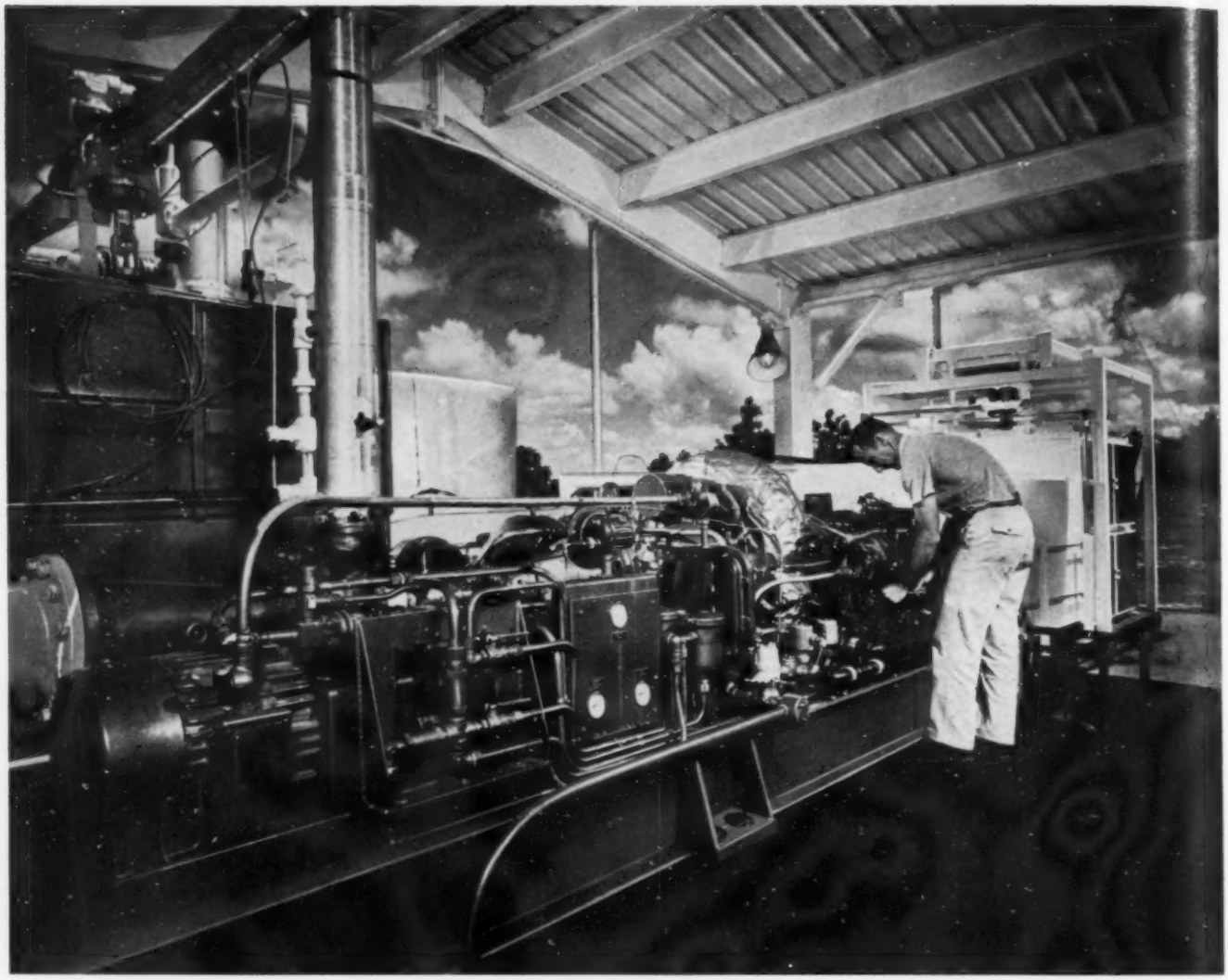

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Because of Solar's customer service program, companies without gas turbine experience can take advantage of this engine's superior performance. Solar's customer service department offers on-the-spot help and off-the-shelf spare parts for fast, efficient service.

For information about Solar gas turbines or field service program, write Dept. J-168, Solar, San Diego 12, California

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WHAT'S HAPPENING IN PIPE LINE CONSTRUCTION

By **Donald G. DePugh,** Construction Editor

Engineering Contract Awarded On 400-Mile, Helium Pipe Line

Williams Brothers Company has been awarded a contract for engineering work on the 400-mile, 4-10-inch helium line for the Department of the Interior.

The helium line will transport helium from conservation plants in the Southwest for storage in Government-owned Cliffside gas field near Amarillo, Texas.

Williams Brothers $1.2 million contract calls for developing specifications for a line starting near Bushton, Kans., ranging from 4 to 10-inch. It will operate at pressures up to 1,800 psi. Contract also covers acquisition of rights of way for the line and inspection services for the Bureau of Mines during construction.

At Cliffside, helium will be stored underground until needed. The Interior Department estimates that the helium program will conserve 52 billion cubic feet in the next 25 years.

The government has signed purchase contracts with National Helium Corporation, owned 50 percent by Panhandle Eastern Pipe Line Co., and Cities Service Gas Company. Both companies are building helium plants in Kansas. The pipe line will tie into these plants and other conservation plants contemplated for the area.

Northern Natural Plans 365 Miles of 2-16-Inch

Northern Natural Gas Company will construct 365 miles of 2-16-inch branch lines in 1962 in an $11 million expansion program. Northern has filed with the Federal Power Commission for authority to build the lines and extend gas service to 65 new communities in four states during the coming year.

The project proposes service to 44 communities in Wisconsion, 17 in Minnesota, three in Iowa and one in Nebraska.

Northern also will lay 14 miles of 26-inch main line, a loop line east of Waterloo, Iowa, and a compressor station. The program will add 38 MMcf daily to Northern's system, and the new communities will be supplied from the Redfield, Iowa storage field.

Natural Gas Storage Plans New Facilities

Natural Gas Storage Company of Illinois has filed with the Federal Power Commission to increase peak day withdrawal capacity of its Herscher, Ill., facilities from 725 to 800 MMcf. The $3.3 million program calls for addition of a 6,500 horsepower compressor engine, field gathering line facilities of 10, 12 and 20-inch lines, and additional wells for injection and observation.

United Gas Pipe Line Plans Expansion Project

United Gas Pipe Line Company has filed four applications with the Federal Power Commission seeking approval for construction of new facilities costing about $6.6 million.

United would lay 40 miles of 24-inch loops on its Mobile-Pensacola line at a cost of $3.8 million. Facilities would be used for delivery of about 49 MMcf of gas daily on that system.

In another proposal, United seeks authority to lay 10 miles of 30-inch loops in Terrebonne and Assumption Parishes, La., costing $1.9 million. United also filed two budget-type applications to carry out minor construction work during 1962.

Natural Gas Map Issued by FPC

The Federal Power Commission has issued June 30, 1961 revision of the map, Major Natural Gas Pipelines in the United States. It supersedes December 1960 issue. It will be sold through the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C.

The map is 13 by 18 inches in size. It has a scale of 170 miles per inch and is printed in five colors. It shows existing lines, lines under construction, or authorized, but not started, and proposed lines pending commission approval.

National Helium Corp. Signs Government Contract

National Helium Corporation will construct a helium extraction plant at Liberal, Kans., designed to produce one billion cubic feet of helium annually. National Helium is a newly formed company owned by Panhandle Eastern Pipe Line Company and National Distillers and Chemical Corporation and has signed a contract with the Department of Interior for sale of all production of its proposed plant.

Construction of the plant is scheduled to start in 1962 and completion is expected in about two years. The plant will include a "deep-freeze" to be used in extraction of helium from natural gas. It will comprise three ten-story high "cold boxes" that will provide a total of 200,000 cubic feet of freezing space—the equivalent of 20,000 home freezers of 10 cubic feet capacity each. Helium will be extracted at minus 300° F from gas that flows into Panhandle's Liberal station.

A billion cubic feet a day of Panhandle's gas, averaging four-tenths of one percent helium, will pass through the helium facility. Panhandle will supply the gas for extracting helium and for fueling the processing operation.

Francis J. McElhatton, vice president of Panhandle, is president of the new company. Ross Wilson, technical advisor at Panhandle, will be operations vice president and Robert H. Cornwell, vice president, engineering, for National Distillers' U.S.I. Chemical Co. division, is vice president.

Helium has many applications including pressurizing missile fuel components, a shield in welding special metals and in some arc welding and there is a great demand being generated for the product.

Transcontinental Gas Pipe Line Announces $49 Million Program

Transcontinental Gas Pipe Line Corporation has filed an application with the Federal Power Commission seeking permission for construction of 188 miles of 36-inch main line loops and 46,800 compressor horsepower.

The $49 million expansion program would add 93.4 MMcf of gas per day to Transco's system. The main line would parallel Transco's system in Louisiana, Mississippi, Alabama, Georgia, the Carolinas, Virginia, Maryland and Pennsylvania. The additional horsepower will be installed in 13 stations in seven states.

The project includes 28 miles of 24-inch and 20-inch gathering laterals in Louisiana; additional horsepower at a compressor station near Eunice, La.; an intermediate station on the McMullen Gathering System in Goliad, Texas; and metering and regulating facilities in Bucks County, Pa.

Work on Transco's 219 miles of 30-36-inch looping program is nearing completion and construction is underway on its final 1961 program of 187 miles of 36-inch loops and other facilities.

Southern Pacific Plans Pipe Line in Oregon

Southern Pacific Pipe Lines, Inc., is considering laying a 100-mile, liquid line from Portland to Albany and Eugene, Ore. It would follow the Southern Pacific railway right of way through western Oregon.

Trunkline Lets Contracts On 88 Miles of 30-Inch

Trunkline Gas Company has awarded contracts on 88 miles of 30-inch gas loop lines between Longville, La., and Tuscola, Ill. Houston Contracting Company, Cape Construction Company and Sharman, Allen, Gay & Taylor, Inc., are the contractors.

Houston is laying 18 miles in the vicinity of Epps, La. Cape Construction will build 22 miles near Joppa, Ill., and 26 miles in the vicinity of Mattoon, Ill. Sharman, Allen, Gay & Taylor has 22 miles between Senetobia and Bahalia, Miss.

Iowa and Illinois Gas Lets Feeder Line Contracts

Gabe Construction Company has been awarded a contract by Iowa and Illinois Gas and Electric Company to build 14 miles of 10-inch feeder main line in Henry and Rock Counties, Ill.

Tennessee Gas Awards Contracts on Six Stations

Tennessee Gas Pipeline Company has awarded contracts for installation of 34,000 additional compressor horsepower on its system. The construction program includes four new stations and horsepower in two existing stations.

Contractors and new station work include Houston Contracting Company, Purvis, Miss., 6,000 hp; O. L. Olsen Company, DeKalb, Miss., 5,500 hp; Arthur Brothers, Inc., Hamilton, Ala., 5,500 hp; and Houston Contracting, Port Sulphur, La., 8,000 hp. Additions to existing stations are at Kinder, La., 2,600 hp by Petrocon, Inc.; and at Portland, Tenn., 6,800 hp by Arthur Brothers.

Mid-America Adds Gas Turbine Engine

Mid-America Pipeline Company will install a 1,000-horsepower gas turbine engine on a centrifugal pump in Whiting, Iowa booster station. The unit will be skid mounted and the turbine will operate off of propane fuel taken from the line.

"Alright Hawthorne, on your feet"

Humble Lets Contract To T-T Construction Co.

Humble Pipe Line Company has awarded a contract to T-T Construction Company, Inc., for 20 miles of 8-inch products line. This is the first phase of Humble's planned products expansion program in Texas which will include 270 miles of 6, 8, 10-inch from Baytown to Austin and San Antonio.

The 20-mile section will connect at Clear Lake to an existing 10-inch line from Baytown to Clear Lake, and extend to Pierce Junction. Company crews will construct two remotely-controlled pump stations, one in Baytown and the other in Pierce Junction.

Construction on the main part of the program will start next year.

Interstate Companies Bought Over 8.1 Trillion Cubic Feet

Interstate gas pipe line companies purchased more than 8.1 trillion cubic feet of gas from independent producers in 1960 at an average cost of 15.6 cents per mcf. Total cost was $1,265,381,342.

Actual purchases amounted to 8,106,413,313,000 cubic feet. This compares with 1959 sales of 7,519,992,780,000 cubic feet at an average cost of 14.3 cents per mcf. In addition to the purchases from producers, interstate companies themselves produced 938,733,722,000 cubic feet of gas in 1960. They also purchased 10,196,987,000 cubic feet of manufactured and liquefied petroleum gas.

Natural gas sold in 1960 came from 23 states and from Canada and Mexico. Of the total sales, 73.7 percent came from two states—Texas, with 44.2 percent and Louisiana with 29.5 percent.

Bechtel Corp. To Lay Texas Eastern Line

Bechtel Corporation will lay 23 miles of 10-inch lines for Texas Eastern Transmission Corporation. The lines will be laid from New Brunswick to Freehold, N. J.

Shell Acquires Interest In Oklahoma Illinois Line

Shell Oil Company has acquired an interest in Oklahoma Illinois Gas Pipeline Company. Oklahoma Illinois plans to construct a 600-mile large diameter gas line from the Anadarko

Basin in western Oklahoma to St. Louis area.

Fish Engineering Corporation and Pan American Petroleum Corporation recently formed the company which will file an application with the Federal Power Commission to build the line. Shell and Pan American, both with large reserves in western Oklahoma, will supply the gas for the system. Headquarters of the new pipe line will be in Tulsa.

FPC Considering Policy Changes

The Federal Power Commission announced that it will grant temporary authority for major gas pipe line construction only after a notice of application has been issued and a hearing held. The commission also is considering a change in rules to provide for rejection of independent producer natural gas sales contracts containing indefinite price escalation clauses and any certificate application by gas companies which rely upon these contracts as proof of gas supply.

The Natural Gas Act permits granting temporary authority under certain conditions without notice and hearing. But, the commission claims that it has on occasion, "interpreted this rather broadly."

Notice and hearing procedure should be accorded unless there is an emergency and the proposed construction is comparatively minor, according to the new policy. The commission urges companies to conduct planning and submit applications well in advance.

The FPC last March amended its rules to provide that indefinite price escalation clauses in sales contracts executed after April 13, 1961 would be inoperative and would have no effect at law. The commission pointed out that the orders issued last March 3 and March 31 held that these provisions "are generally undesirable, unnecessary and incompatible with the public interest . . ." The commision stated that it thus "appears that no useful purpose can be served by the Commission's acceptance of contracts containing the indefinite price escalation provisions or of applications relying upon contracts having such provisions. Commissioner Jerome K. Kuykendall dissented on the amendment saying it would place an unnecessary burden on FPC staff and parties concerned.

PROPOSED PIPE LINE CONSTRUCTION

Here in convenient summary form is Pipe Line Industry's listing of company, line size, length, service, location and project status.

*** indicates that this item is a new entry or that status of this project has changed since last appearance.**

U.S.

American Petrofina, 133 miles, 6-inch, products, Mount Pleasant, Texas to Grapevine, Texas, $2.5 million, planned.

Algonquin Gas Transmission Co., Boston, 25 miles, 20-inch; 8 miles, 8-inch, gas, and 12,000 hp addition in Massachusetts, $6 million, FPC Authorization.

Ashland Oil & Refining Co., Ashland, Ky., 24 miles, 6-inch, crude, Blaine to Catlettsburg, Ky., planned.

Border Gas Transmission Company, 300 to 400 miles, gas, gathering, in South Texas, $10 million, planned.

California Gas Transmission Company, Los Angeles, (subsidiary of Tennessee Gas Transmission Company), 292 miles, 20-34-inch gas, from Mexico-California border near Mexicali, to Los Angeles and 10,000 hp. to tie into Texas Mexico-California line, $50 million, before FPC and California Public Utilities Commission.

Coastal Transmission Corp., Houston, 71 miles, 3 to 10-inch, gas, laterals; 5,500 hp in stations at Port Lavaca, Texas and Eunice, La. and 1,500 hp at Robstown, Texas, $7 million, FPC authorization.

Colorado Gas Transmission Co., 250 miles, 20-inch, gas, Southwest Colo., to Colorado Springs, before Colorado PUC.

Colorado Interstate Gas Co., Colorado Springs, 140 miles, 34-inch, gas, Green River, Wyo.,-to-Provo, Utah; 109 miles, 26-inch, Texas Panhandle to southeastern Colorado, 136 miles, 34-inch, southeastern Colorado-to-Pueblo, Colo.; 107 miles, 30-inch, Pueblo-to-Denver, $91 million, FPC conditional authorization.

Colorado Oil & Gas Corp., Denver, 400-miles, gas, from Gubik field to Fairbanks, Alaska, planned.

Columbia Gulf Transmission Company, Houston, 97 miles, 30-inch, loops in Kentucky, Tennessee, Mississippi and Louisiana; 29 miles, 12-inch lateral in Louisiana, $15 million, before FPC.

* **Department of Interior,** Washington D.C., 400 miles, 4-10-inch, helium, Bushton, Kans. area to Amarillo, Texas, contract let to **Williams Brothers Co.** for engineering.

El Paso Gas Supply Company, El Paso, Texas, 228 miles, 30-inch, gas, main, Live Oak to Sutton County, Texas, $30 million, before FPC.

El Paso Natural Gas Company, El Paso, 199 miles, 30-inch, Permian-San Juan crossover loop, before FPC.

34 miles, 20-inch, Puckett to Goldsmith, before FPC.

23 miles, 20-inch, Goldsmith to Eunice-Plains line, before FPC.

9 miles, 20-inch, Goldsmith-Plains loop, before FPC.

43,600 hp in new and existing stations in Texas, Oklahoma, New Mexico and Utah, before FPC.

400 miles, 34-inch, Salt Lake City, Utah, to California border, FPC conditional authorization.

35 miles, 8-inch, gas, to deliver gas to Southern Union Gas Company in Dallas, $1 million, before FPC.

Equitable Gas Company, Pittsburgh, Pa., 31 miles, 16-inch, and 26 miles, 20-inch, in West Virginia and Pennsylvania, $5 million, before FPC.

Great Northern Pipe Line Co., 64 miles, crude, extension to Lignite field, North Dakota, planned.

Houston Texas Gas & Oil Corp., St. Petersburg, Fla., 235 miles, 2-6-inch, gas laterals, 30,000 hp in five new stations; $16 million, FPC authorizations.

* **Humble Pipe Line Company,** Houston, 270 miles, 6,8,10-inch, products, Baytown to San Antonio and Austin, Texas, contracts let on 20 miles, 8-inch to **T-T Construction Co.**

Kansas-Nebraska Natural Gas Company, Hastings, Neb., 165 miles, 2-8-inch, gas, extension from Alliance, Neb., to Chadron, Crawford, Hemingford, Hay Springs, Gordon and Rushville, Neb., before FPC.

45 miles, 2-3-inch, gas, in Kansas, approved by Kansas Corporation Commission.

2,000 hp addition at Scott City, Kan., FPC approval authorization.

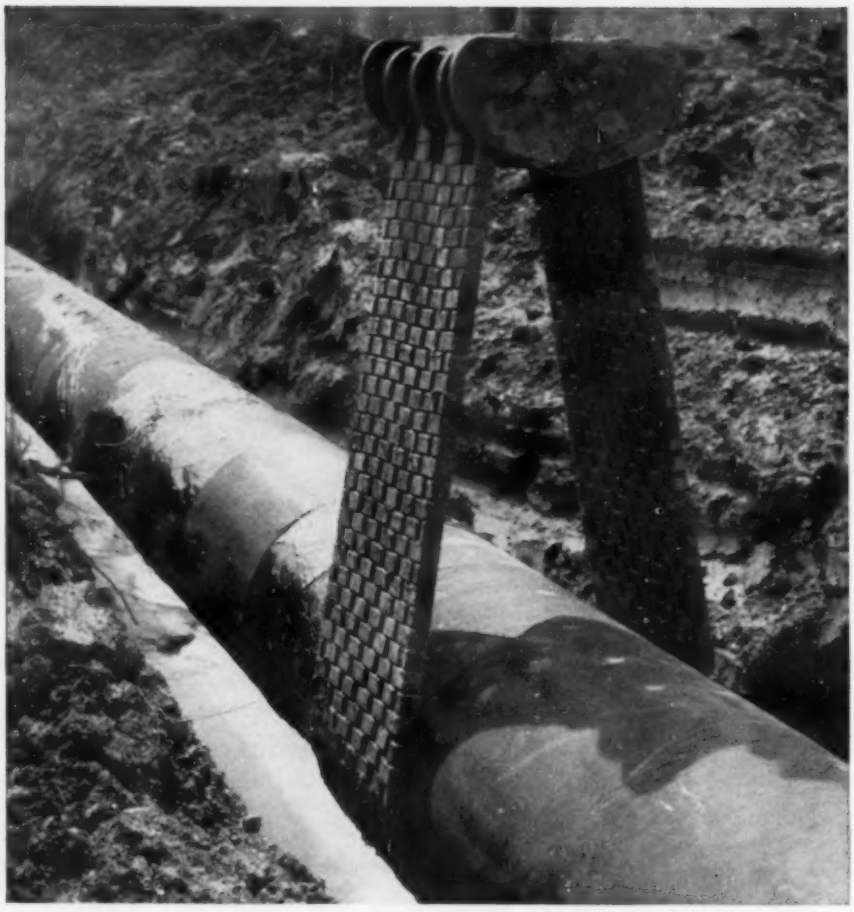
2,500 hp addition at Holcomb, Kan., before FPC.

Lone Star Gas Company, Dallas, 47 miles, gathering lines in Palo Pinto, Erath and Stephens counties, Texas, planned.

Lone Star Gathering Company, Dallas, 63 miles, gas, gathering, in DeWitt and Victoria counties, Texas, $2½ million, planned.

Long Island Pipeline Company, New York, 75 miles, 20-inch, products, Linden, N. J., to Long Island, N. Y., $30 million, planned.

(Continued on Page 82)



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How to put a pipeline in its place with a rugged Swing Sling*

Mr. Francis Phillips, construction superintendent of Ford, Bacon & Davis Construction Corporation, Monroe, Louisiana expresses his opinion of CF&I-Wickwire Swing Slings in no uncertain terms.

"Without any question", asserts Mr. Phillips, "our new Swing Slings used for lowering-in operations saved us time and cut labor costs on the job. They always performed the way we wanted. Putting other types of belts and slings in position is a man-sized job for two or even three 'swampers', but one man can position and hook up a Swing Sling. When tension is released, the Swing Sling drops and its end hooks disengage themselves. Most important, other types of belts and slings are frequently chewed up by load shifts; with Swing Slings this doesn't happen, since they flex and shift laterally to keep the load evenly distributed."

The Swing Sling's tough, neoprene covering (over strong aircraft cables) provides gentle cushioning action and good flexibility. Its wide-bearing surface (up to 36") often makes it possible to replace two standard wire rope slings with one Swing Sling when handling long pipe sections. To find out how the Swing Sling pays for itself many times over, contact your nearby CF&I office.

8400-A

*Trademark—Patent Pending

The Colorado Fuel and Iron Corporation
Denver • Oakland • New York
Sales Offices In Key Cities

PROPOSED CONSTRUCTION

continued

Lo-Vaca Gathering Co., (Coastal States Gas Producing Co.) 230 miles, 6-20-inch, gas, gathering, Live Oak to Lavaca County, Texas, planned.

Matador Pipe Line Corp., Denver 175 miles, crude, from Bottineau, Burke and Renville counties, N. D., to Cromer, Man., Canada, $4 million, proposed.

Michigan Wisconsin Pipe Line Company, Detroit, 88 miles, gas, 3,000 hp, take gas from Northern Natural at Janesville, Wis., before FPC.

Mid-American Pipe Line Co., 405 miles, 10-inch, LPG, Superior, Wis., to Chicago, $12 million, considered.

100 miles, LPG, extension from Ogden City, to Charles City, Iowa, planned for 1962.

Monterey Gas Transmission Company, Houston, 216 miles, 30-inch, gas, Clear Lake, Texas, to Alexandria, La., planned.

New Haven Pipeline, Inc., products line, New Haven, Conn. to Springfield, Mass., $2.5 million, planned.

Northern Natural Gas Company, Omaha, 50 miles, gas line, 2,000 hp, before FPC. 99 miles, gas, 4,660 hp, $8.9 million, before FPC.

365 miles, gas, branch lines, and 14 miles, 26-inch $11 million, before FPC.

Northern Gas Products Co., (subsidiary of Northern Natural Gas Co.), 350 miles, 8-inch, LPG, Bushton, Kan., to Des Moines, Iowa, $12 million, planned.

Northwestern Refining Co., crude gathering system, Rival and Lignite fields, North Dakota, $625,000, Public Service Commission approval.

Ohio Fuel Gas Co., 59 miles, gas, 4-24-inch main lines, in Belmont, Carroll, Cuyahoga, Fairfield, Logan, Lorain, Marion, Muskingum, Stark and Wayne counties, Ohio, $5.1 million, planned.

Oklahoma Illinois Gas Pipeline Co., (Fish Engineering, Shell Oil Company, Pan American Petroleum Corp.) 550 miles, gas, Woodward, Okla., to St. Louis, planned.

Pacific Gas & Electric Co., San Francisco, 120 miles, 30-inch gas loops, Topock to Milpitas, before FPC.

44 miles, 3-20-inch, gas, gathering, in Sutter and Colusa Counties, Calif., $2.3 million, planned.

Pacific Lighting Gas Supply Co., Los Angeles, 24 miles, 16-inch, gas, Gaviota to Goleta, Calif. $1.7 million, before Public Utilities Commission.

Panhandle Eastern Pipe Line Co., Kansas City, 305 miles, 30-inch, 40 miles, 26-inch, gas, loops, and 43,000 hp, and gathering facilities, $60 million, before FPC.

200 miles, 22-24-inch, gas, lateral, from Elk City, Okla., to Haven, Kan., $15. million, before FPC.

Olympic Pipe Line Co., 324 miles, 6-16-inch, products, Ferndale, Wash. to Portland, Oregon, $17.5 million, planned.

Pennsylvania Railroad, products pipe lines along railroad's right of way to serve Friendship Airport in Baltimore and Washington's National Airport, Andrews Air Force Base, and Dulles International Airport, considered.

Phillips Pipe Line Co., Bartlesville, Okla., 75 miles, main line, 85 miles, gathering crude, from Camrick field, Gray, Okla., to Phillips, Texas, planned.

Southern California and Southern Counties Gas Cos., Los Angeles, 93 miles, 34-inch, California-Nevada border to Newberry, Calif.

Southern Pacific Pipe Lines, Inc., Los Angeles, 100 miles, liquid Portland to Albany and Eugene, Ore., considered.

St. Lawrence Gas Company, Inc., Ogdensburg, N. Y., 75 miles, gas, main, United States-Canadian border to Ogdensburg, N. Y., $3.4 million, FPC approval.

Suwanee Pipe Line Co., (Sinclair Oil Corp.) Atlanta, 800 miles, 22-inch, products, Baton Rouge to Greensboro, N. C., planned.

Tennessee California Gas Transmission Company, (subsidiary of Tennessee Gas Transmission Co.), 100 miles, 26-inch, gas, gas fields in South Texas to Texas-Mexico border near Reynosa, before FPC.

Tennessee Gas Pipeline Co., Houston 167 miles, 30 and 36-inch loops in Ohio and Pennsylvania, and 36,800 hp in 4 new and 3 existing stations, $38 million, before FPC.

18,300 hp in 3 new stations, $6 million, FPC authorization.

50 miles, 26-inch loop in Kentucky, FPC authorization.

21 miles, 16-inch, 2 miles, 12-inch, gas, offshore Louisiana, Vermilion blocks 46 and 64, $2.3 million, before FPC.

84 miles, 10-20-inch, gas, offshore Louisiana, FPC authorization.

Texas Eastern Transmission Corp., Shreveport, La.

66 miles, 30-inch, gas, loops, between Vidor, Texas, and Lambertville, N. J., and 33,710 hp in four existing stations, $17.5 million, temporary FPC authorization.

144 miles, gas, 46,300 hp. $27.8 million, for 1962, before FPC.

Texas Eastman Company, Longview, Texas, 280 miles, 6-inch, products, Houston to Longview, contract let on 207 miles to **O. R. Burden Construction Corp.**

Texas Power & Light Company, 230 miles, 6-16-inch, gas, Anderson County, east Texas to Fannin County and McKinney-Denton area, planned.

* **Transcontinental Gas Pipe Line Corporation, Houston.**

188 miles, 36-inch, gas, loops, in Louisiana, Mississippi, Alabama, Georgia, North and South Carolina, Virginia, Maryland and Pennsylvania; 46,800 hp in 13 stations; 28 miles, 20-24-inch gathering laterals in Louisiana; $49 million, before FPC.

13 miles, 24-inch and 18 miles, 20-inch loops, Louisiana, FPC authorization. 14 miles, 16-inch laterals, 1-mile, 12-inch lateral, Louisiana, $2.1 million, FPC authorization.

29 miles, 20-inch, gas, and 2,500 hp, in South Texas to take gas from South Texas Natural Gas Gathering Co., $2.4 million, FPC authorization.

Trans-Southern Pipeline Corp., Houston, 1,080 miles, 12-inch, LPG, from Mont Belvieu, Texas, to Danville, Va., and 215-mile spur line from Atlanta to Georgia-Florida border, $63 million, planned.

Trunkline Gas Company, Houston, 97 miles, 30-inch, loops, between Longville, La., and Tuscola, Ill., 27 miles, supply laterals, and two 6,000 horsepower compressor stations, contract let to Slearman, Allen, Gay & Taylor, Cape, Construction, and Houston Contracting Co.

United Gas Pipe Line Co., Shreveport, La., 40 miles 24-inch gas, loops on Mobile-Pensacola line, $3.8 million, before FPC.

10 miles, 30-inch, loops, Terrebonne and Assumption Parishes, La., $1.9 million, before FPC.

Utah Gas Pipeline Corp., 200 miles, gas, San Arroya and Bryson Canyon fields to Salt Lake City, $15 million, planned.

Valley Gas Transmission, Inc., Houston, 55 miles, 3 to 8-inch, gas, gathering, in Hidalgo, Brooks, Starr and Jim Wells counties, Texas, $15 million, before FPC.

International

ACT Oils, Ltd., Montreal, 400 miles, crude, Dawson Creek, B. C., to Bella Coola, B. C., before B. C. Government.

Ajax Alberta Pipeline Ltd., 28 miles, 10-inch, gas, main, Morinville to Westlock, Alta., planned.

Assistencia de Oleodutos du Petrobras, Rio de Janeiro, 280 miles, 12-inch, crude, Rio de Janeiro to Belo Horizonte, Brazil, planned.

Alberta Gas Products System, Ltd., 725 miles, 8-12 inch, gas liquid gathering system, to connect with Trans Mountain system for delivery to U.S. border, before Alberta Conservation Board.

Bituminous Oil Pipeline Co., Calgary, 250 miles, crude, from Athabasca tar sand plant in northeastern Alberta to Edmonton, approved.

Britamoil Pipe Line Co. Ltd., 64 miles, 8-inch, gas-liquids, Rimbey to Edmonton, Alberta, $2 million, authorized.

British American Oil Co., Ltd., Toronto, 125 miles, gas, Pincher Creek fields to Calgary, Alta., before Alberta Public Utilities Board.

Burmah Oil Co., Ltd., 850 miles, crude, 20 inch, from Nahorkatiya to Calcutta, India. Contract let on 250 miles to Mannesmann-Saipem.

Cartier Gas Corp. (St. Maurice Gas, Inc., and Consumers Gas Co., Toronto), 170 miles, gas, Montreal to Quebec City, planned.

Consolidated Gathering Systems, Ltd., Calgary, 198 miles, crude, Sturgeon field to Edmonton, planned.

Empresa Nacional Calvo Sotelo, Madrid, Spain, 150 miles, 14-inch, crude, main line, Malaga to Puertollano, Spain, $10 million, planned.

Gas del Estado, Buenos Aires, 1,050 miles, 30-inch, gas, Comodoro Rivadavia field to Buenos Aires, $380 million, bids submitted for design and construction by Texas Eastern Transmission Corp., ENI, and an Argentine firm.

Gas Trunk Line of British Columbia, Vancouver, 250 miles, 30-inch, gas, main, Fort Nelson to Taylor, B. C., planned.

Gasversorgung Sueddeutschland, 180 miles, gas, Mannheim to Karlsruhe to Kehl and Ulm, $20 million, planned.

Hudson's Bay Oil & Gas Co. Ltd., Calgary, 41 miles, 4-8-inch, condensate, Waterton-Castle River area and Pincher Creek field to Carway to connect with Glacier system, authorized.

Hughenden Pipeline, 125 miles, products, Dick Lake gasoline plant to Hughenden Region, Alta., planned.

Independent Pipe Line Co., 2,019 miles, 34-36-inch, crude, Edmonton to Montreal, 23,000 pump horsepower, $395 million, before Borden Commission.

International Gas Co., Los Angeles, 1,800-miles, 30-inch, gas, Reynosa to Mexicali at California border, considered.

Interprovincial Pipe Line Company, 350-mile extension from Toronto to Montreal, looping line from Edmonton to Toronto, crude, $240 million, considered, products pipe line, Superior, Wis., to Chicago, considered.

90-mile, crude, Hamilton, Ont., to Buffalo, N. Y., before National Energy Board of Canada.

Kuwait Oil Co., 30 miles, 22, 24, 26-inch, crude, Minagish field to Ahmadi, planned.

Mid-Continent Pipe Lines, Ltd., 1500-mile, 30-inch crude, Edmonton to Chicago, planned.

Naphtha Israel Oil Co., 75 miles, 6-inch, gas, Rosh-Zohar field to Ashdod Yam on Mediterranean planned.

National Iranian Oil Co., 146 miles, 6 inch, crude, from Azna to Isfahan, Iran, $5 million, planned.

Northern Alberta Pipe Lines, Ltd., Edmonton, Alta., 110 miles, 10-inch, gas, main, Lac La Biche to Edmonton, $3 million, planned.

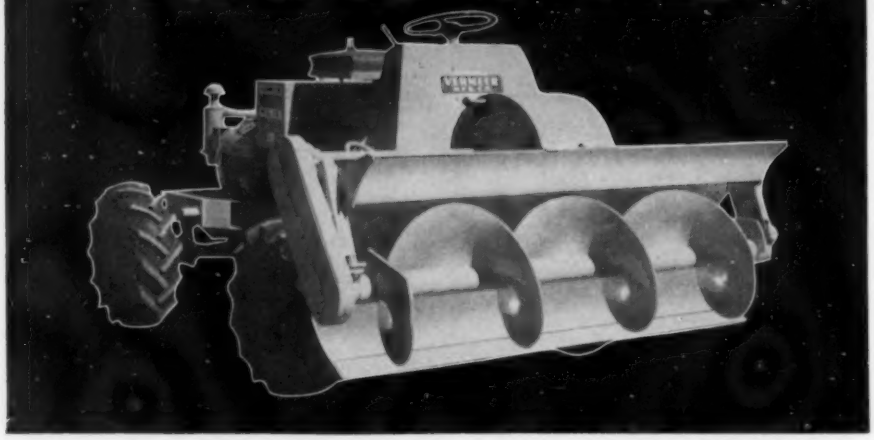
Northern Pipe Line Company, 153 miles, 16-inch, crude, from Regina, Saskatchewan, to Clearbrook, Minn., $10 million, planned.

Rhein-Donau Oletung, G.m.b.H, 185 miles, 24-inch, crude, Karlsruhe to Ingolstadt, $7.5 million, planned.

Peace River Oil Pipe Line Co., Ltd., 161 miles, 12-inch, crude, main line, Fox Creek to Edmonton, Alberta, planned.

(Continued on Page 84)

NEW VERMEER POW-R-BACKFILLER



BIG, FAST, RUGGED MACHINE ENDS "BACKFILL PROBLEMS"!

Now, in one pass, you can deposit dirt back into a ditch at a lower cost and a higher speed than you ever thought possible . . . with Vermeer's new Pow-R-Backfiller. Here's a highly maneuverable 4-wheel drive unit with power steering that will backfill at speeds from 20 to 150 feet per minute, depending on backfilling conditions. Features a big 8′ x 24″ tilting auger that stays parallel with the ground while rotating. Assures a clean, smooth job under toughest conditions. The Vermeer Pow-R-Backfiller will not only cut your ditch filling labor and cleanup time, but also reduces your backfill equipment costs.

Just A Few Vermeer Backfiller Features . . .

- Powered by 36 HP Wisconsin Engine.
- Transport Speed—8 mph.
- Hydraulically operated 8′ Auger tilts 5 degrees.
- Backfilling speed from 20′ to 150′ per minute.
- Hydraulically controlled power steering.
- Ideal for contractors, utilities, municipalities.

Highly maneuverable Pow-R Backfiller is jointed at the center for easy steering, better control and greater ground grip.

One pass does it—depositing dirt neatly and quickly into ditch. Adjacent area is cleared of all dirt and debris.

MAIL COUPON FOR FULL INFORMATION - LOW PRICES

Please send me complete information, literature and price of your new Vermeer Pow-R-Backfiller.

NAME _____

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CITY _____ STATE _____

VERMEER POW-R-LINE PELLA, IOWA

VERMEER MANUFACTURING CO.

1403 W. WASHINGTON • PELLA, IOWA

PROPOSED CONSTRUCTION

continued

Petroleos Mexicanos, 4, 6 and 8-inch, products, Mexico City-Puebla to Cuernavaca, planned.

1,240 miles, 34-inch, gas, Reynosa to Mexicali, Mexico, $160 million, negotiating with Tennessee Gas Pipeline Company for design and construction of the line.

360 mile, 12-inch, products, Minatitlan to Puebla and Mexico City, planned.

Products, Guadalajara to Tepic, planned.

Products, Aguascalientes to Zacatecas, planned.

6-inch, products, Guaymas to Ciudad Obregon, considered.

8-inch products, Guaymas to Hermosillo, considered.

Gas, Ciudad Carmen to Ciudad Pemex.

8-inch, crude Comalcalco to Minatitlan.

Crude, Minatitlan to Salina Cruz, contingent on proposed refinery on Pacific Coast.

149 miles, 10-inch, products, Ciudad Pemex to Minatitlan, planned.

181 miles, 4-inch, products, Mexico City to Salamanca, planned.

Pipelines of Puerto Rico, Inc., 95 miles, 8-inch, products, Penuelas to San Juan, Puerto Rico, approved.

Quebec Gas Transmission Lines, Inc., Montreal, 300 miles, gas, main, Quebec to Montreal, planned.

Rangeland Pipe Line Company Limited, 111 miles, 8-inch, crude, southeastern Alberta to Calgary, $3 million, planned.

Royalite Oil Co. Ltd., 26 miles 4-inch, products, in Alberta, authorized.

Saskatchewan Power Corp., 179 miles, 4-6-8-inch, gas, planned.

Societa Nazionale Metanodotti, 650 miles, 18-inch, crude, Genoa to Milan-Cremona-Torino, Italy, and Aigle, Switzerland, with extension to Karlsruhe and Munich, Germany, contract let on Italian portion to Saipem.

Societe du Pipe Line Sud-European, Paris, 432 miles, 34-inch, crude, port of Lavera to Strasbourg, with lateral extending 40 miles to Karlsruhe, Germany, underway.

Soc. Siciliana Metanadotti, gas line from Hassi R'Mel field in Algeria through Tunisia, across Mediterranean to Sicily and into Italy, considered.

Soc. Trapil, 200 miles, 12-inch, crude, La Havre to Paris, France, planned.

Standard-Vacuum Oil Company, 60 miles, 8-inch, gas, main, in South Sumatra, considered.

Ste. d-Etudes de Pipeline Intercontinetaux, Paris, 1,400 miles, 30-40-inch, gas, from Hassi R'Mel field in central Algeria across Mediterranean, through Spain, France and into West Germany, considered, Fish International Corporation making engineering and feasibility studies.

Sui Gas Transmission Co., Multan, Punjab, India, 145 miles, 8-inch, gas, from Sylhet to Dacca, East Pakistan, $9 million, considered.

130 miles, 16-inch, gas, main line, Multan to Lyallpur, planned.

Syrian Pipeline, Damascus, 500 miles, crude, from Karshuk field, Syria, to Mediterranean, planned.

300 mlies, products, from Homs to tank farms in Damasucs, Aleppo and Latakia, contract let to Techint, Inc.

Trinidad and Tabago Electricity Commission, Trinidad, 42 miles, 16-inch, gas Penel field to Port-of-Spain, planned.

Trunk Pipelines Ltd., London, 70 miles, products, Canvey Island to Denham, Buckinghamshire, bill before Parliament. Extension of line from Denham to Birmingham, planned.

Yacimientos Petroleos Fiscales Argentina, Buenos Aires, crude line between Mendoza and Buenos Aires, considered.

ENI Starts Work On Crude Lines

Construction is underway on ENI's crude pipe line system in Italy. Saipem has contract for the 18-inch line from Genoa to Milan-Cremona-Torina, Italy.

The line will be operated by SNAM, a subsidiary of ENI.

Plans call for extending the crude system into Switzerland and possibly farther to Karlsruhe and Munich Germany.

Curran & Company Gets Canadian Work

Rimbey Pipe Line Co. has let a contract to Curran & Company for construction of 70 miles of 8-inch line between Rimbey and Edmonton, Alta.

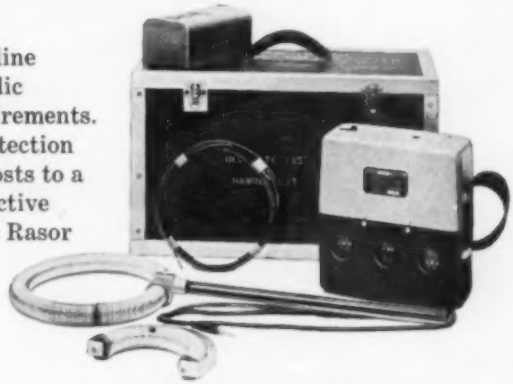
"Allow me!"

INSPECTION IS THE KEY TO GOOD PIPE COATING

TINKER & RASOR HOLIDAY DETECTORS

insure coating continuity

Every void in your pipeline coating increases cathodic protection current requirements. To obtain maximum protection and hold maintenance costs to a minimum, inspect protective coating with a Tinker & Rasor Holiday Detector and make repairs before backfilling.



Tinker & Rasor E P Holiday Detector.
Portable, "damp-climate" pulse type.

Write for your free Data Kit.

Tinker & Rasor has prepared a complete data kit of descriptive material and recommended procedures for inspecting protective coatings. Material includes technical data on equipment, recommended inspection procedures, general discussion of types of detectors, theory of operation, etc.

ENGINEERING NOTE:
To insure a perfect application, include Tinker & Rasor Holiday Inspection. Write for specification guide.

Quality Control for Coating Application

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For more data on advertised products, use cards, last page.

ON THE LINE

FPC Commissioner Changes

Commissioner Jerome K. Kuykendall will resign as a member of the Federal Power Commission January 1962. Kuykendall took office in the FPC in 1953 and served as chairman for more than eight years. Joseph C. Swidler succeeded him as chairman in September, 1961.

A Republican, Kuyendall is the last commissioner still serving under appointment by former President Eisenhower. He will enter private law practice in Washington after January.

Kuykendall was chairman of the Washington Public Service Commission prior to his appointment as FPC chairman. He also served as assistant attorney general of the state of Washington before and after World War II. During the war he was a lieutenant in the Navy.

Charles R. Ross, former chairman of the Vermont Public Service Commission, is the latest member to join the Federal Power Commission. His term expires June 22, 1964. He succeeds the late Commissioner Frederick Stueck, who died July 15.

The commission now consists of Chairman Swidler, vice chairman Howard Morgan, L. J. O'Connor, Jr., Ross, all appointed by President Kennedy, and Kuykendall. Ross is a Republican who served as a member of the Burlington Board of Aldermen from 1957 until 1959, and was president of New England Conference of Public Utility Commissioners in 1960.

Part of Civil Defense

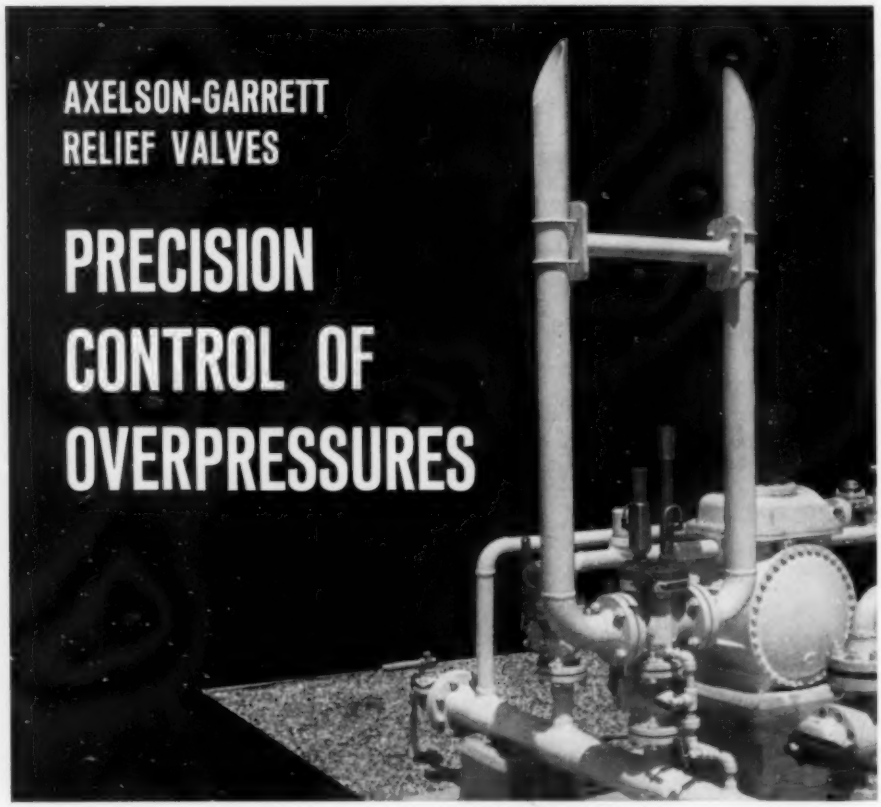
Pacific Lighting Gas Supply Company has requested from the California Disaster Office four kits to monitor radioactive fallout. The company already has such equipment at its Glendale base.

The new units are scheduled for Montebello, Mills Road dispatch center, Goleta and Taft. Personnel will be trained how to operate the units. At Glendale, dispatch personnel were given a basic "Radiological Meter Operator" course.

Fact, Fiction on Fallout Shelters

The Chamber of Commerce of the United States has issued a leaflet covering fallout shelters. The four page leaflet explains some of the fact and fiction involved in fallout shelters and nuclear attack.

The informative publication has proved popular according to the Chamber of Commerce which has filled orders for more than 175,000 copies. The leaflet is available, free of charge, upon request, from Chamber of Commerce 1615 H. Street N.W., Washington 6, D.C.



Why take chances on overpressure damage to lines and vessels when you can have positive protection with Axelson-Garrett Pressure Relief Valves.? Dependable and automatic, they relieve, blow down and reseat within extremely close limits . . . often within 1% of system operating pressure . . . available in operating range of 25 to 6,000 p.s.i.

Changing conditions are no problem either, as the controls can be set externally with exactness and will maintain accuracy of set and reset pressure over unlimited cycles, with no pressure accumulation. There is a bonus in maintenance savings, too . . . Axelson-Garrett Relief Valves do not "chatter" or "simmer" . . . fast, positive opening eliminates wear on valves and seats.

Check with your Axelson-Garrett representative or write direct on how you can add these economical safety valves to your installation . . . ask for bulletin #RV.

Products Designed To Give OIL A Lift

USI Axelson-Garrett

DIVISION OF U.S. INDUSTRIES, INC. GENERAL OFFICES: LONGVIEW, TEXAS

WHY 754,900 FEET OF SPANG PIPE WERE USED FOR NEW SEADRIFT PIPELINE

Seadrift Pipeline Corporation, a subsidiary of Union Carbide Corporation, used three quarters of a million feet of SPANG seamless line pipe in their new 108-mile dual pipeline from Seadrift, Texas, to the Humble Oil Company gas plant near Ella, Texas.

There are many reasons why oilmen feel safe when they specify SPANG pipe. They know that SPANG has taken every precaution to assure strength, ductility and uniformity of the pipe. SPANG pipe has been serving industry needs successfully since 1840. It is produced by National Supply, the world's largest supplier of oil country equipment and products.

These are a few of the reasons why SPANG pipe is preferred by oilmen. The next pages cover additional reasons.

PIPELINERS FIND SPANG SEAMLESS PIPE IS

754,900 feet of SPANG seamless line pipe were used by the Seadrift Pipeline Corporation, a subsidiary of Union Carbide Corporation, in this new pipeline from Seadrift, Texas, to Ella, Texas. Order was made up of 3½", 4½", and 6⅝" O.D. pipe.

DUCTILE, EASY TO WELD, UNIFORMLY ROUND

Stringent quality control in every phase of production and shipment. This is probably the most important reason for the superiority of SPANG pipe in gathering, distribution and transmission lines.

Quality control is a specialized business in National Supply's modern Ambridge mill, where SPANG pipe is made. This control starts with the chemical and physical properties of the steel and is carried through every step of production and inspection.

The finished pipe is subjected to thorough testing through internal and external surface inspections, hydrostatic tests and dimensional controls, such as O.D., wall thickness, end bevel and straightness checks.

At the end of production and inspection cycles, and before SPANG is stenciled on the pipe, we are sure it meets the appropriate API specification.

Uniformity of SPANG pipe is an important benefit. The uniform roundness speeds welding. And pipeline crews like the SPANG ductility for operations over rough terrains.

SPANG seamless line pipe for gathering, transmission and distribution lines is readily available in sizes from 2 inches (nom.) through 14 inches O.D., and in specifications API STD. 5L and API STD. 5LX.

Next time you buy pipe, play it safe. Order SPANG seamless pipe from your National Supply representative, or write to National Supply Division, Armco Steel Corporation, Two Gateway Center, Pittsburgh 22, Pa.

Stenciling the SPANG name is final step in production of high-quality pipe under standards that meet API specifications.

Steel's Symbol of strength, long life, and economy

Steel

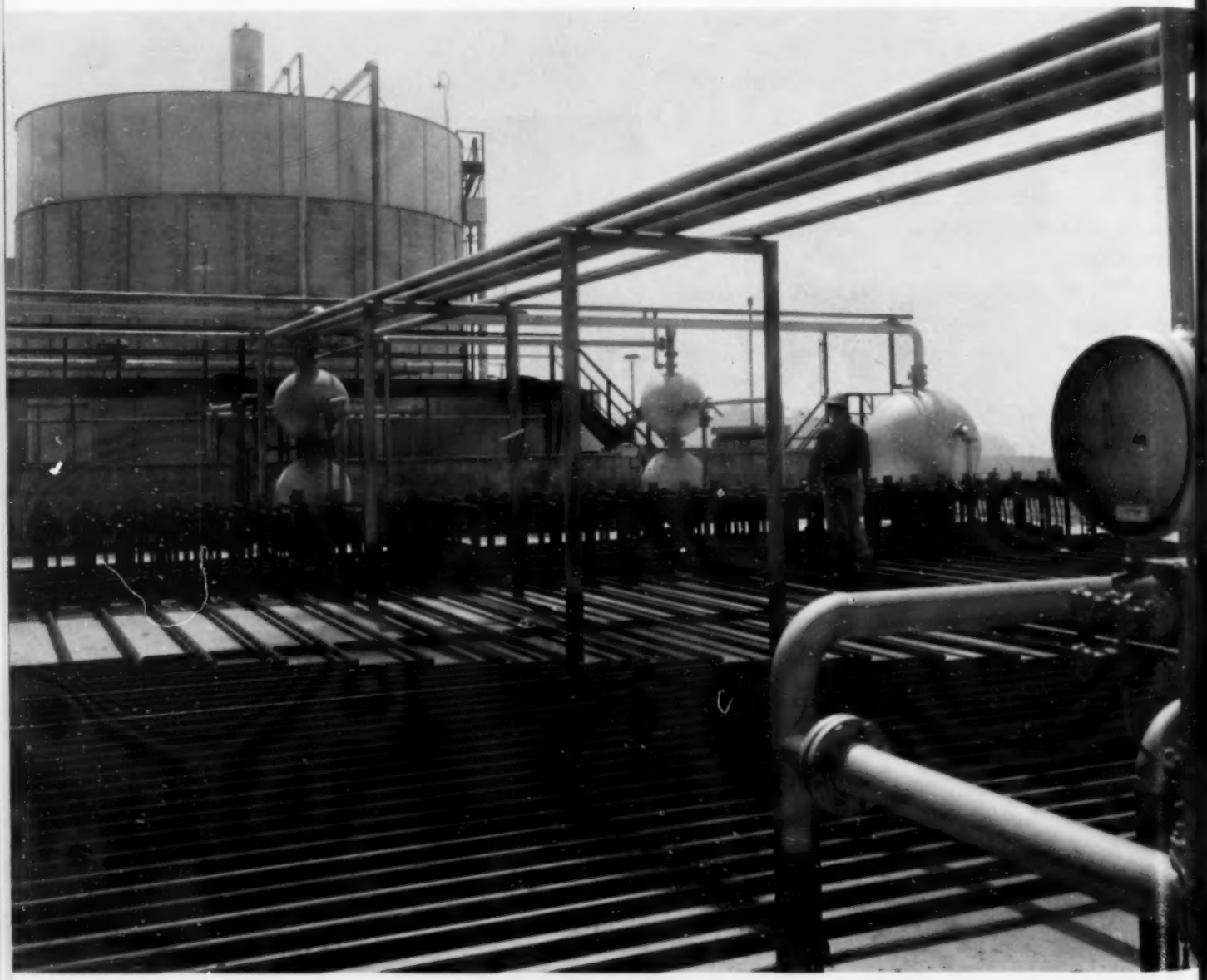
SPANG pipe is produced by National Supply at Ambridge, Pa., in a modern pipe mill, where quality control is the prime consideration.

SPANG PIPE SPEEDS INSTALLATION OF GATHERING AND FEEDING LINES

National Supply also produces SPANG CW butt-weld pipe under stringent controls. Every length is hydrostatically tested and inspected for thread quality and uniformity.

All SPANG pipe is made of carefully selected steel that meets the toughest standards. This control assures you of pipe that is easy to work, because it is easy to cut, bend, thread and weld.

Call your nearby National Supply representative, or write to National Supply Division, Armco Steel Corporation, Two Gateway Center, Pittsburgh 22, Pennsylvania.



Gathering line service is one of many oil field applications for SPANG CW pipe. In addition to gas, oil and water lines, you can use it for many structural purposes.

ARMCO National Supply Division

What's Happening

among MEN in the INDUSTRY

World's Largest Helium Plant Set

A 20-year contract has been signed by the United States Department of the Interior with National Helium Corporation for all the production of its helium plant which will be built at Liberal, Kans. John M. Kelly, assistant secretary of Interior Department, center, completed contract signing with Alden F. Whitehead, legal counsel for National Distillers and Chemical Corp., left, and Francis J. McElhatton, president of National Helium and vice president of Panhandle Eastern Pipe Line Co. Panhandle and National Distillers own National Helium. Plant will be built next year.

Alan M. McRae has been named manager of **Winnipeg Pipe Line Company** Limited succeeding the late T. R. Scott, McRae had been operations superintendent of **Sarnia Products Pipe Line.**

Mills Cox has resigned as president of **Transwestern Pipeline Company,** but will remain as a director of the company. Cox has served with the company for four years. Transwestern has not appointed Cox's replacement, but an executive committee has been named to head the company. **J. R. Butler,** committee chairman, **W. K. Warren,** chairman of the board, **Nelson C. Turner,** and **W. B. Padon,** vice presidents, make up the executive committee.

Henry W. Ziethen has been elected assistant vice president of **Peoples Gas Light and Coke Company.** He had been superintendent of tax administration department. Ziethen has been with Peoples since 1918.

Paul B. Ridlon has been appointed division superintendent of **Cities Service Pipe Line Co.** His area includes Kansas, Texas, and southern Louisiana. Ridlon joined Cities Service in 1947.

Lawrence H. Gall has been named executive director of the **Independent Natural Gas Association of America.** He succeeds **John A. Ferguson,** who retired and is serving as a consultant to the board of directors.

Houston Pipe Liners Club Elects Officers

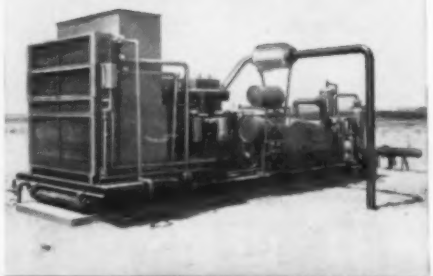
The Houston Pipe Liners Club has named new officers and directors for the 1961-62 year. Officers include Dick Newsome, Trunkline Gas Company, president; Joe Willing, Humble Pipe Line Company, vice president; Len Parent, Trunkline, secretary; and Bob Dillon, Trunkline, treasurer. Newly elected directors are P. D. Phillips, Jr., Humble and Bill Bruyere, Houston Contracting Company. From left to right are Mel Judah, editor of PIPE LINE INDUSTRY, outgoing president who remains a director; Parent, Willing, Newsome and Dillon.

WAUKESHA

for reliable and profitable

COMPRESSOR POWER

Waukesha 1197 cu. in. engine driving packaged gas booster unit—Oklahoma



Waukesha 3520 cu. in. engine on heavy duty compressor application—Texas

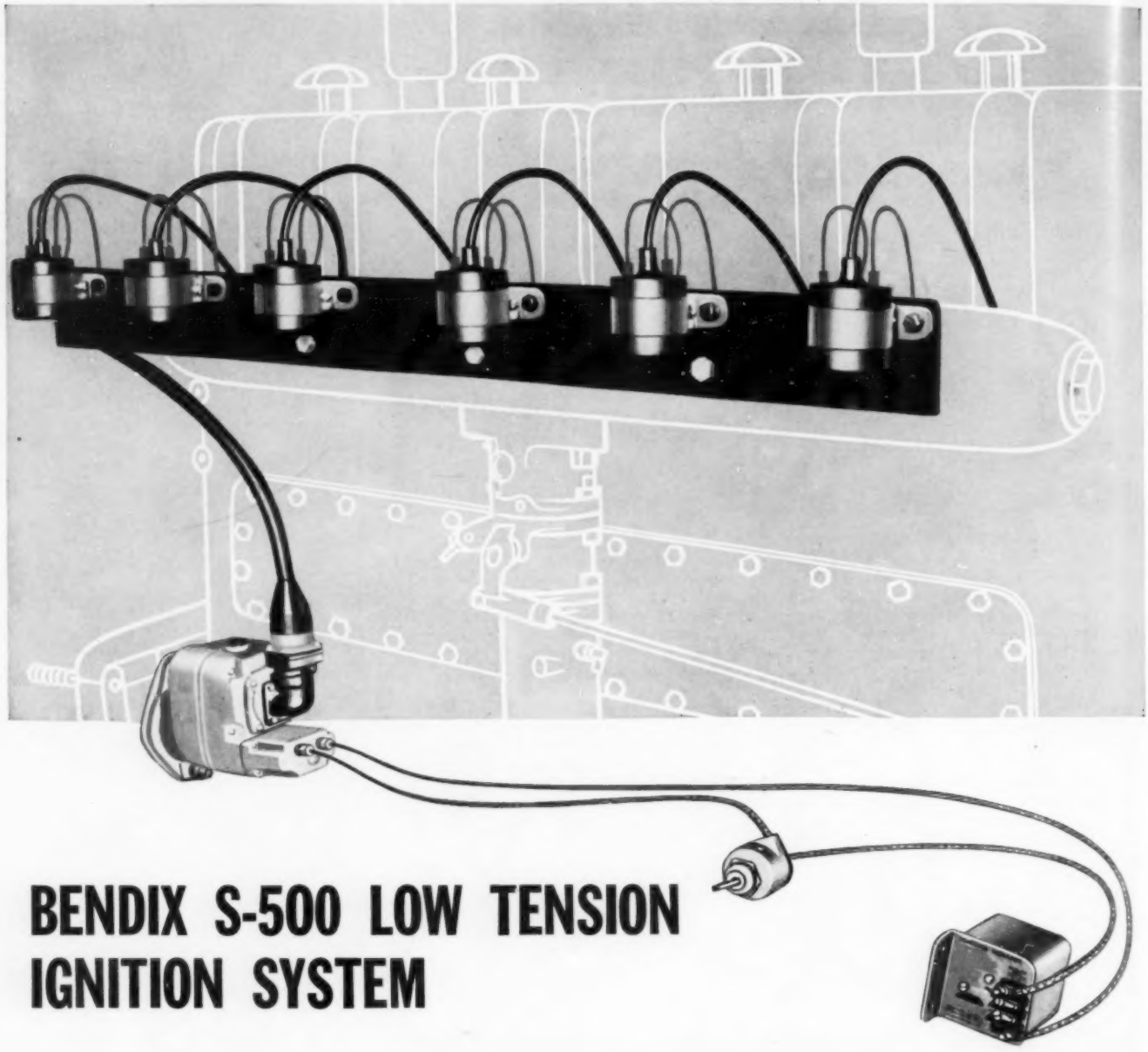
All the proven features that insure long engine life and the ability to withstand overloads, and that result in low maintenance costs and economical operation, are built into these Waukesha engines . . . from precision-counterbalanced rugged crankshafts; pistons, rings, and rod and pin assemblies in matched sets, to built-in automatically lubricated governors and big capacity cooling and oiling systems. The line is complete; you can get exactly the right power for your needs. You can't buy better engines for continuous heavy duty compressor operation.

494

SEE OUR CATALOG IN PIPE LINE CATALOG

WAUKESHA MOTOR COMPANY
WAUKESHA, WISCONSIN
NEW YORK TULSA LOS ANGELES
Factories: Waukesha, Wis., and Clinton, Iowa

The latest for small-to-medium industrial engines



BENDIX S-500 LOW TENSION IGNITION SYSTEM

The S-500 System provides the ultimate in starting and operating efficiency for your four, six, and eight cylinder industrial engines. Specify the new Bendix S-500 Low Tension Ignition System. It features "the modern starting concept"—retard breaker magneto and starting vibrator system.

This complete Low Tension Ignition System—including transformer coils, wiring cable assembly, starting vibrator, ignition and starting control switch, and retard breaker magneto—is custom-engineered to assure positive ignition at all cranking speeds and varied retard requirements. It is furnished in base or flange mounting, flameproof and radio shielded, is adaptable for manual or automatically controlled installations.

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THE Bendix CORPORATION

W. M. Elmer

W. M. Elmer, president of **Texas Gas Transmission Corporation**, was elected president of the Independent Natural Gas Association of America at its convention held recently in Houston. **Orville S. Carpenter, Texas Eastern Transmission Corporation** president, was named first vice president and **George P. Garver**, president of **Natural Gas Pipeline Co.**, was selected second vice president.

Bechtel Corporation announces the appointment of **Gerard J. Forney** as executive engineer in the International Division.

Humble Oil & Refining Company has appointed **E. D. Pressler** coordinator of reserves in the headquarters exploration department. He has been with the company since 1928.

John LeRoy Smith has been named to succeed **J. S. Stearns** as tax commissioner for **Service Pipe Line Co.** Stearns retired after over 37 years of service.
Smith has been with Service since 1950.

Alberta Gas Trunk Line Company named **James W. Knowles** assistant pipe line superintendent for the Trunk Line System. He joined the company in 1957 and presently is headquartered in Calgary.

Arthur G. Meck has been named manager of **Tidewater Oil Company's** eastern pipe line department. He had been area supervisor at Watson, Calif. in the western department.

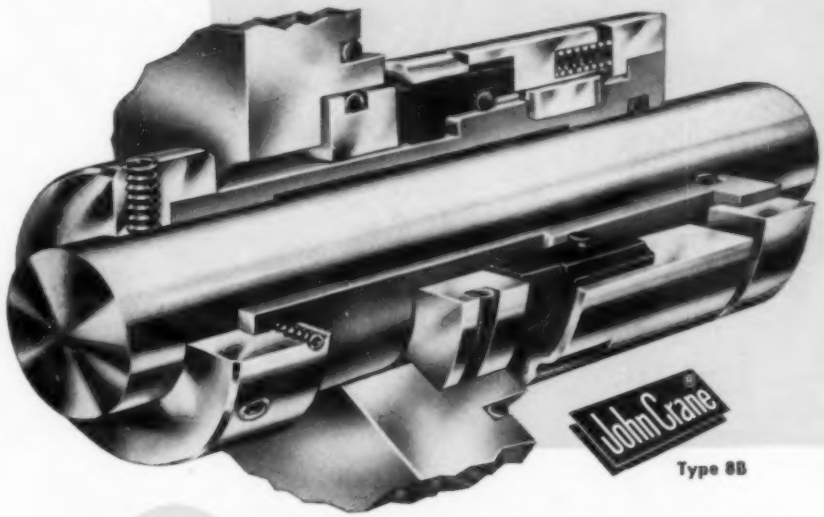
Dr. Henry R. Linden has been appointed director of the **Institute of Gas Technology.** He succeeds **Dr. Martin A. Elliott,** who has been named academic vice president of **Illinois Institute of Technology,** with which IGT is affiliated.

William H. Blakewood of Liberty, Miss., was honored by **Interstate Oil Pipe Line Company** at a 40-year service luncheon last month. Blakewood joined Interstate in 1918 at Weller pump station, firing old steam boilers. He has been station engineer at Liberty station since 1949.

Allen D. Dorris has been named vice president and director of **Sohio Pipe Line Company. Oakley M. Turner** was appointed vice president and **Walter A. Terpenning** treasurer.
Dorris has been with the company since 1948 and recently became superintendent —administration in the transportation division of supply and transportation department. Turner became a gager for Sohio in 1939 and recently was named general superintendent of transportation's Southwestern and Tri-state regions. Terpenning came to Sohio in 1948 and in 1957 was elected secretary, a position he still holds.

The American Society of Mechanical Engineers named Clifford H. Shumaker to serve as president of the 50,000 member organization for the term beginning June 1962.
Shumaker is chairman of the department of industrial engineering of Southern

THIS IS THE SEAL USED IN 75% OF ALL RECENT PIPE LINE PUMP INSTALLATIONS



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Reports from the field reveal that after 2½ years of continuous operation "John Crane" Type 8B Seals are still in perfect operating condition. This adds up to over 20,000 hours without shutdown!

Man-hours are being saved. The 8B is quickly installed and adjusted simply by sliding the entire unit along the shaft into position. The top casing need not be removed.

High pressure problems are eliminated. "John Crane's" exclusive hydraulically balanced construction permits handling of pressures up to 1200 psi.

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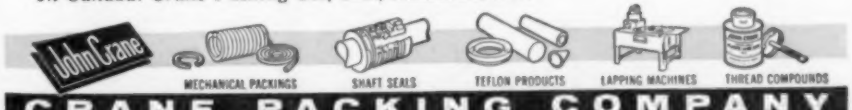
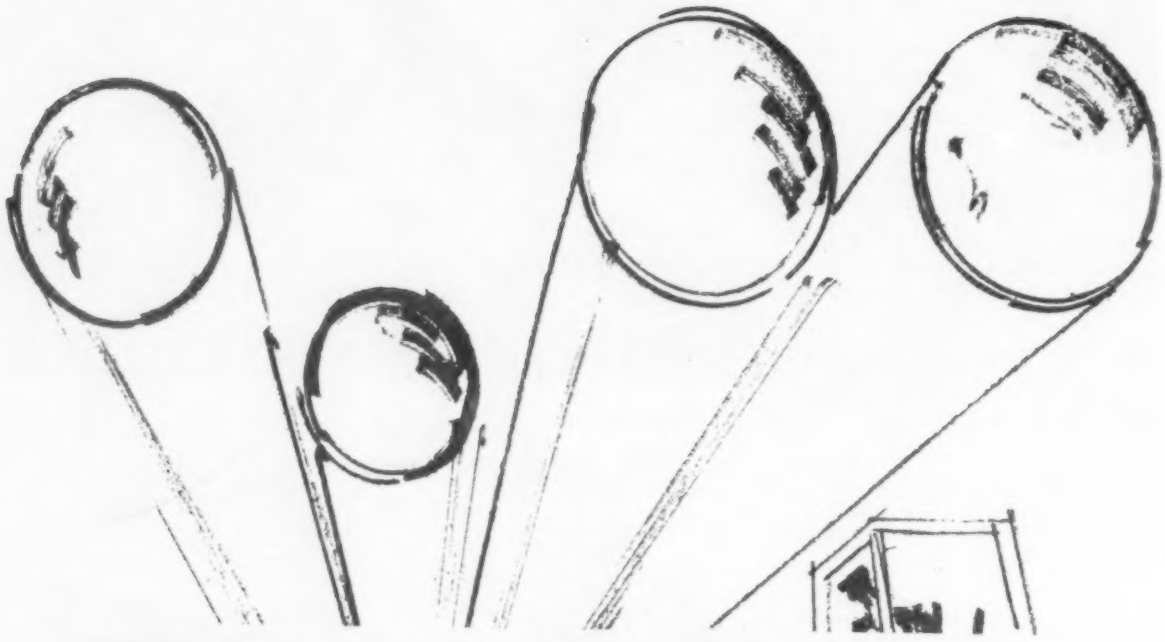
In Canada: Crane Packing Co., Ltd., Hamilton, Ont.

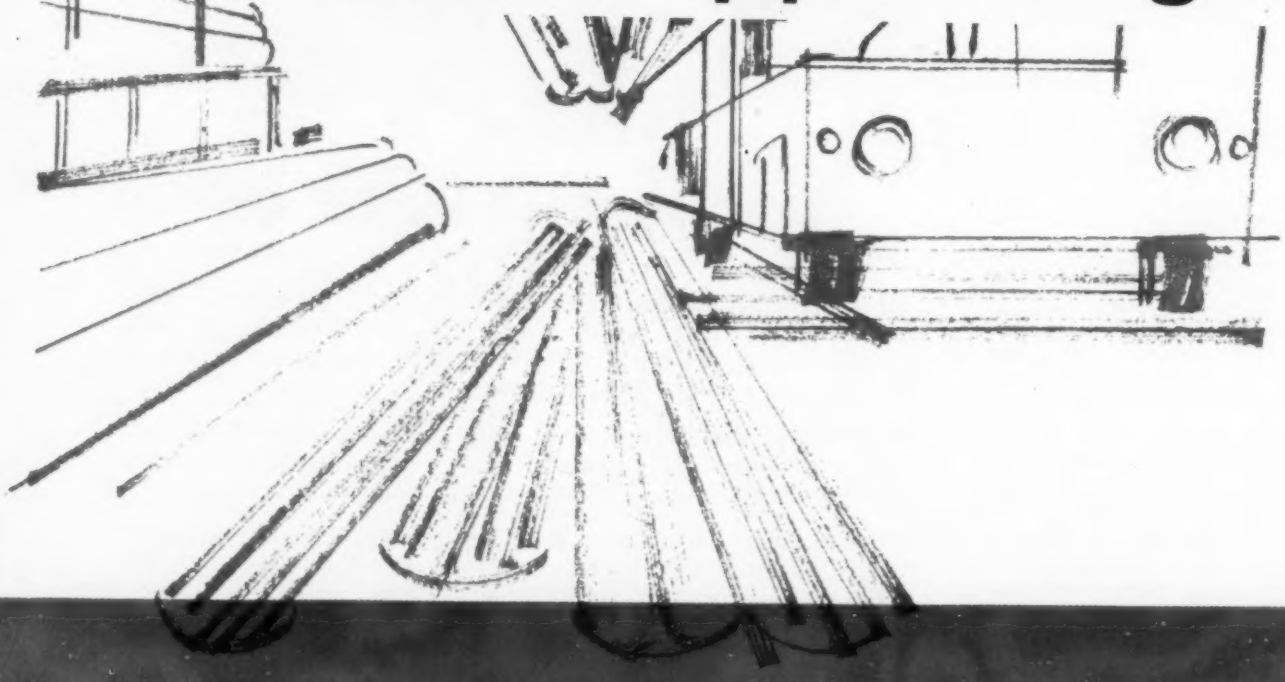


CRANE PACKING COMPANY

For more data on advertised products, use cards, last page.



Wherever pipe lines go . . . .



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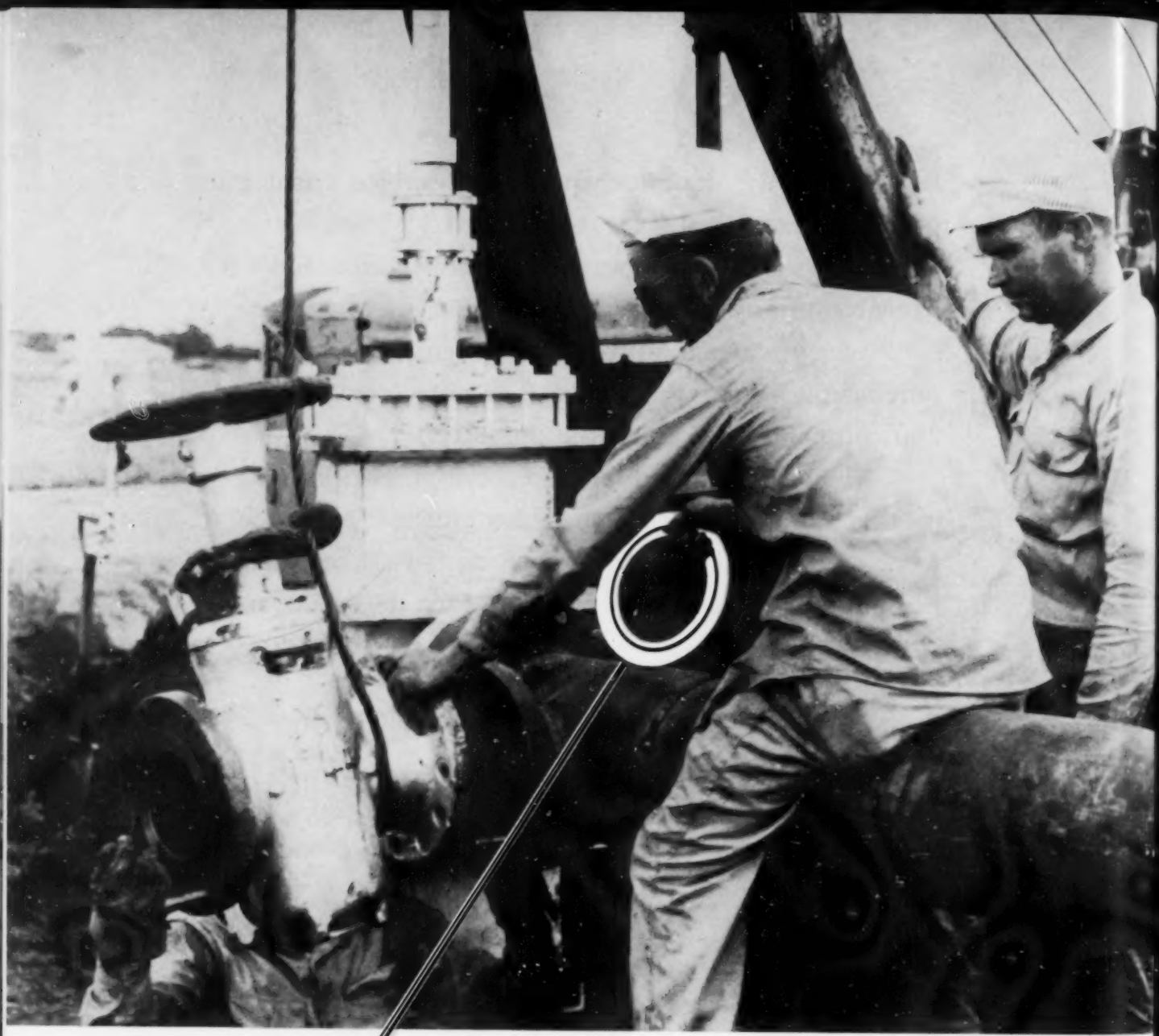

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Methodist University, a post which he has held since the department's formation in 1952. He has served as an ASME vice president and member of the council.

Named as vice presidents for two year terms were **Edward H. Walton, United Illuminating Company,** New England Area (Region I); **Robert W. Worley, United Engineering and Construction Company,** North Atlantic-Pennsylvania Area (Region III); **Robert Nelsen, General Electric Company,** Michigan, Ohio, West Virginia Area (Region V); **Niles H. Barnard, University of Nebraska,** Dakotas and North Great Plains Area (Region VII); **Emmett E. Day, University of Washington,** Pacific Coast Area (Region IX); and **Thomas J. Judge, International Paper Company,** South Atlantic Gulf Coast States (Region XI).

Robert O. Koch

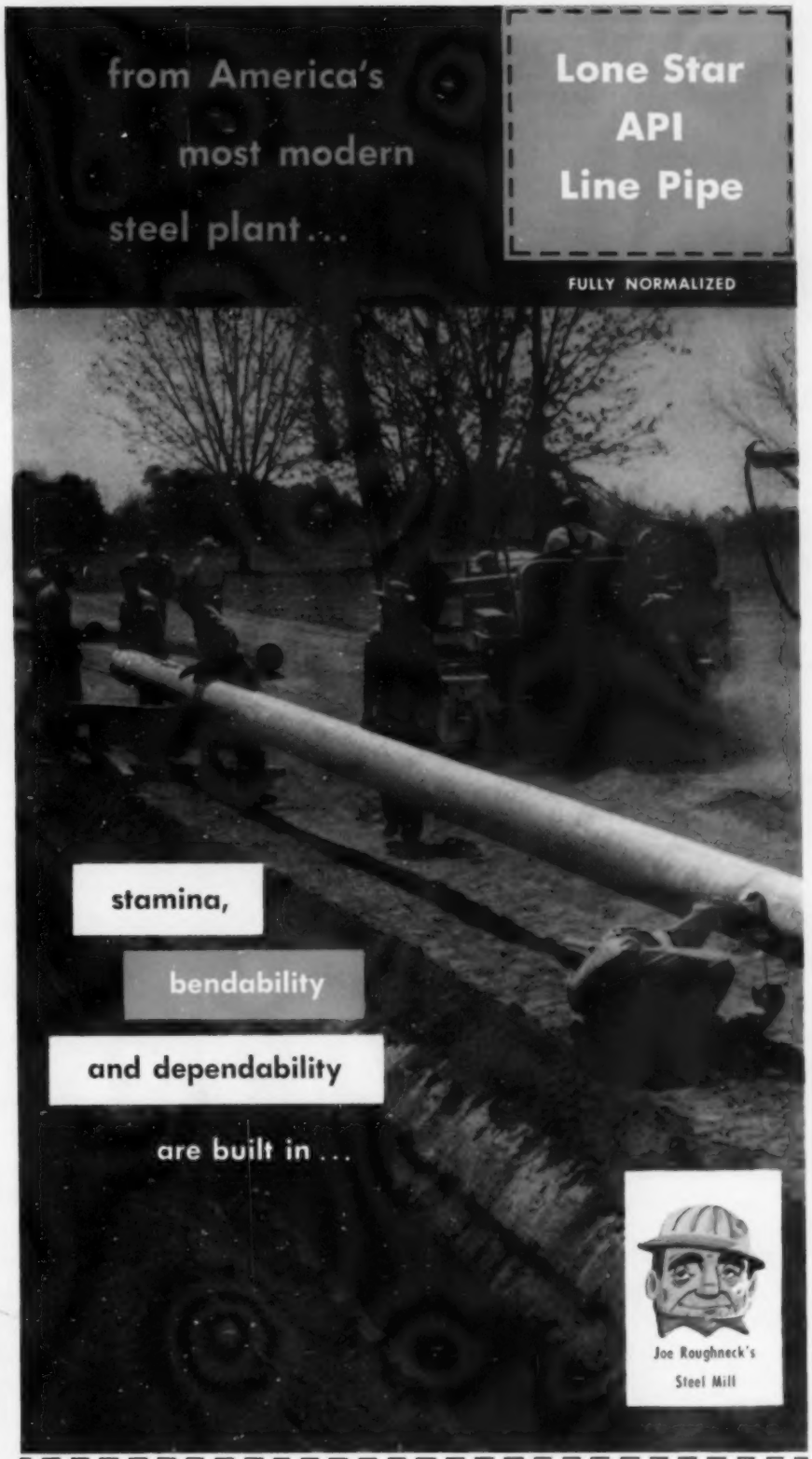
James B. Henderson

Robert O. Koch has been named vice president and general counsel of Texas Gas Transmission Corporation. Koch had been with Tidewater Oil Company since 1948.

James B. Henderson has been named executive vice president of **Transcontinental Gas Pipe Line Corp.** He had been Transco's vice president and general counsel for 12 years and he became a member of the board earlier this year.

On West Shore Work

Deck Road Boring Company officials on road crossing at Chicago on West Shore Pipe Line Company spread include Robert W. Miller, superintendent; B. R. Deck, president; and H. M. Jones, general manager. Deck is located in Corpus Christi, Texas.



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For more data on advertised products, use cards, last page.

C. R. Williams has been named assistant treasurer of Service Pipe Line Company, succeeding **W. E. Taylor,** who retired.

C. R. Williams

Service also announced that its Stafford, Kansas district has been discontinued and its operations combined with the Hays, Kansas district.

The new district is under supervision of Lee May, Hays district superintendent. Area foreman. **C. E. Stephens** will continue to be headquartered at Stafford.

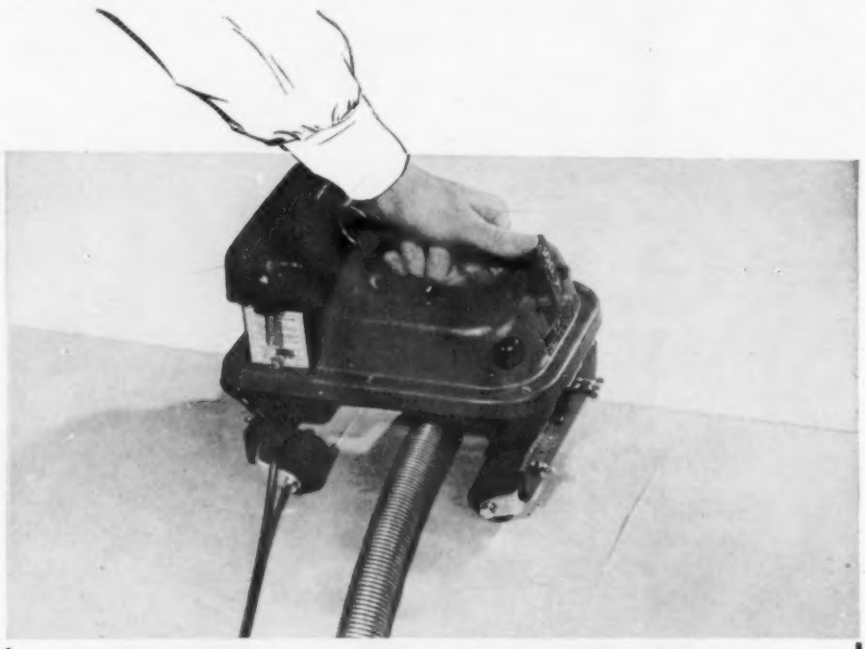
John C. Diehl, chairman of the board of **American Meter Company,** received the Hanlon Award, which is conferred annually by the NGAA for outstanding service to the natural gasoline and gas processing industries. Diehl becomes the twenty-fifth recipient of the award. E. I. Hanlon, chairman of the board of National Bank of Tulsa, and a pioneer in the industry, is the donor of the award.

Deaths

Tommy Thompson, president of Petroleum Electric Power Association, died of a heart attack in Mobile, Ala., September 20. Thompson had been with the Public Service Company of Oklahoma.

Warren T. Bulla, 66, former director of operations for Natural Gas Pipeline Company, died August 27. Bulla was one of the founders of the Petroleum Industry Electrical Association. He retired in 1960 and had undergone surgery in December last year.

O. A. Melvin, Carboline Co., died in Houston October 14. He had served as chairman of the Houston Section of the NACE this year.



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WHO'S MEETING WHERE

November

Society of Automotive Engineers, national fuels and lubricants meeting, Shamrock Hilton Hotel, Houston, November 9-10.

API, annual meeting, Chicago, November 13-15.

NGAA, Panhandle Plains Regional meeting, Herring Hotel, Amarillo, Texas, November 17.

ASME, annual meeting, Statler Hilton Hotel, New York City, November 26-December 1.

NACE, Southeast Regional conference, and Florida General Conference, Key Biscayne Hotel, Key Biscayne, Fla., November 27-Dec. 1.

December

Interstate Oil Compact Commission, annual meeting, Denver Hilton Hotel, Denver, December 4-6.

1962

January

Pipe Line Contractors Association, annual convention, Boca Raton Hotel, Boca Raton, Florida, January 7-10.

March

NACE, 18th annual convention, Municipal Auditorium, Kansas City, Mo., March 19-23.

April

PIEA-PESA, annual convention and exhibit, Dallas, April 10-12.

ASME, oil and gas power division conference, Shoreham Hotel, Washington, D. C., April 15-18.

AGA, Transmission Section, and SGA, annual convention, Houston, April 30-May 2.

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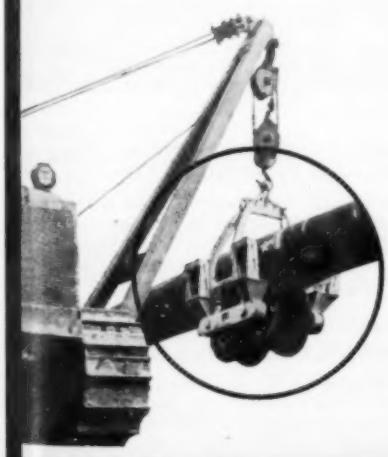
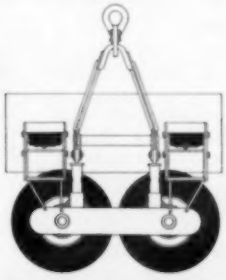
- ELIMINATES "LEAPFROGGING"
- SPEEDS OPERATION

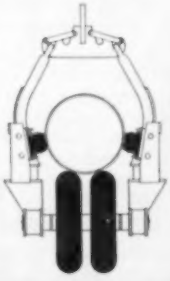
Crose-Perrault's Pneumatic-Tired Lowering-in Cradle consists of an adjustable frame with rubber guide rollers and large pneumatic conveyor rollers. Coated and wrapped pipe is gently guided into the ditch while the tractor moves steadily along the line.

Permits one tractor to make continuous progress lowering pipe into the ditch. Saves the time lost in tractor maneuvering when two tractors must move around each other, unhooking and hooking up in order to move down the line. One tractor, making continuous progress along the ditch, can cover as much as three times the line as the two tractor "leapfrogging" method of lowering in. Available for three groups of pipe diameters: 4" to 12", 12" to 24", and 20" to 36".

For more detailed information, write today.







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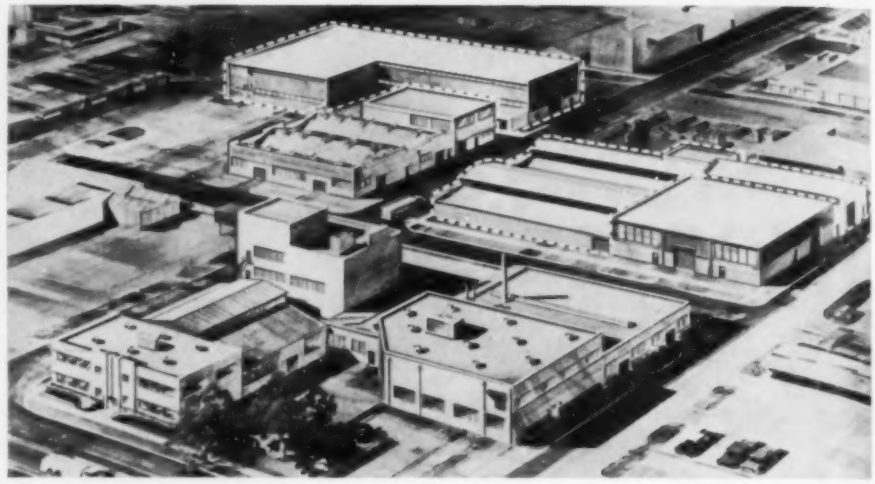


Maloney Plans Plant Expansion

Two new buildings will be added to F. H. Maloney Co.'s facilities in Houston with a $650,000 expansion program announced. The new facilities will add 48,000 square feet to firm's plant. Buildings will house a production line for meter provers and launchers and expand other departments.

Polyken Names W. J. McDade Field Sales Representative

W. J. McDade has been appointed field sales representative for Polyken Sales Division and will handle pipe line coatings. He has been assigned a Midwestern territory and is headquartered in Chicago. He had been with Northern Illinois Gas Company.

Foxboro Names Huckman General Sales Manager

Edward R. Huckman has been appointed general sales manager for Foxboro Company Ltd. He will be in charge of all industrial instrument sales for the Montreal firm. He had been assistant field sales manager for The Foxboro Company the past three years.

Republic Steel Promotes Gault to Assistant Manager

Frank E. Gault has been appointed assistant manager of sales for Pipe Division of Republic Steel Corporation. He had been vice president for Republic Supply Company, a subsidiary.

Air Reduction Appoints Werly Marketing Manager

G. L. Werly was named general marketing manager of Air Reduction Company. He will handle operations of company's equipment marketing, gas marketing and distributor marketing departments located in the New York office.

Du Pont Plans to Build Pipe Plant in Tulsa

The Du Pont Company will construct a plant in Tulsa to manufacture its Derlin acetal resin pipe. Plant will be designed with a 5 million pound annual capacity and will be in production next summer. It will be located in the Tulsa industrial center about six miles southwest of the city. Plant will be operated by Du Pont's Polychemicals Department.

Datex Corporation Names Wulfe Field Sales Engineer

Raymond F. Wulfe has joined the Datex Corporation as a field sales engineer and will be headquartered in the Dallas office. He had been with Telechrome Manufacturing and was a district engineering sales manager.

Minneapolis-Honeywell Names R. T. Waits, Jr., Industrial Manager

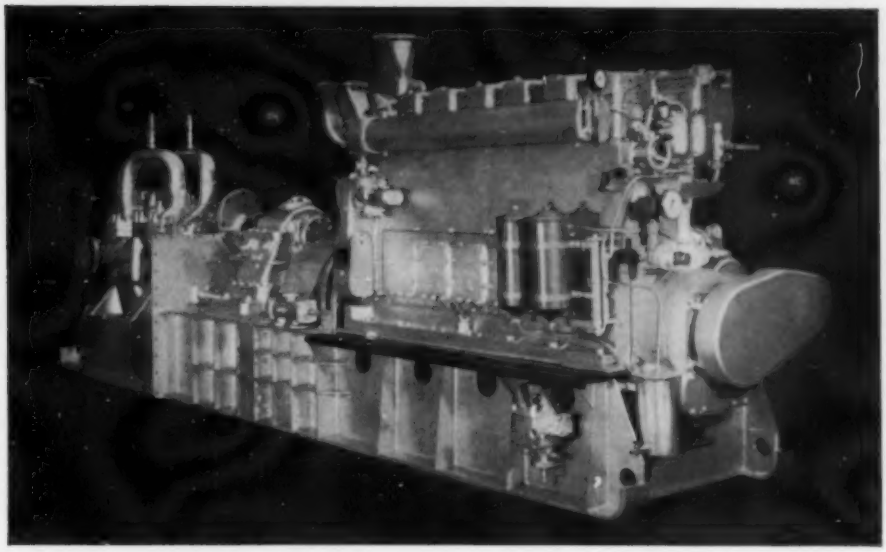
Richard T. Waits, Jr., has been named eastern regional industrial manager for Minneapolis-Honeywell Regulator Company. He succeeds D. W. Fryback, who becomes account executive at Hartford, Conn. Waits will be headquartered in Long Island City, N. Y. He has been with Honeywell since 1945.

Mavor-Kelly Company Relocates Warehouse

Mavor-Kelly Company has relocated its warehouse facilities from Gretna to 428 Julia Street in New Orleans. It will stock and service the Koppers line of Bitumastic coatings, Carey and Tapecoat.

Dresser Manufacturing Names Castle Sales Representative

Harry R. Castle has been appointed sales representative for Dresser Manufacturing Division for Michigan, Northern Indiana and Western Ohio. He will be responsible for marketing pipe joining and



Explosion-protected Pipe Line Pumping Set consisting of MWM four-stroke Diesel type TRHS 526 S rated for 310 HP at 850 rpm and four-stage KSB Pump type GPL – 1000 with a delivery of 120 m^3/hr (70.5 cu. ft/min) at 526 lbs/in^2 gauge pressure.

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The MWM Diesel Engine production programme is conceived to provide for the largest possible field of application, comprising four-stroke engines from 8 to 2000 HP. For the Petroleum Industry we supply rugged powerful engines to drive field equipment, complete high pressure pipe line pumping sets and Diesel-generator units.

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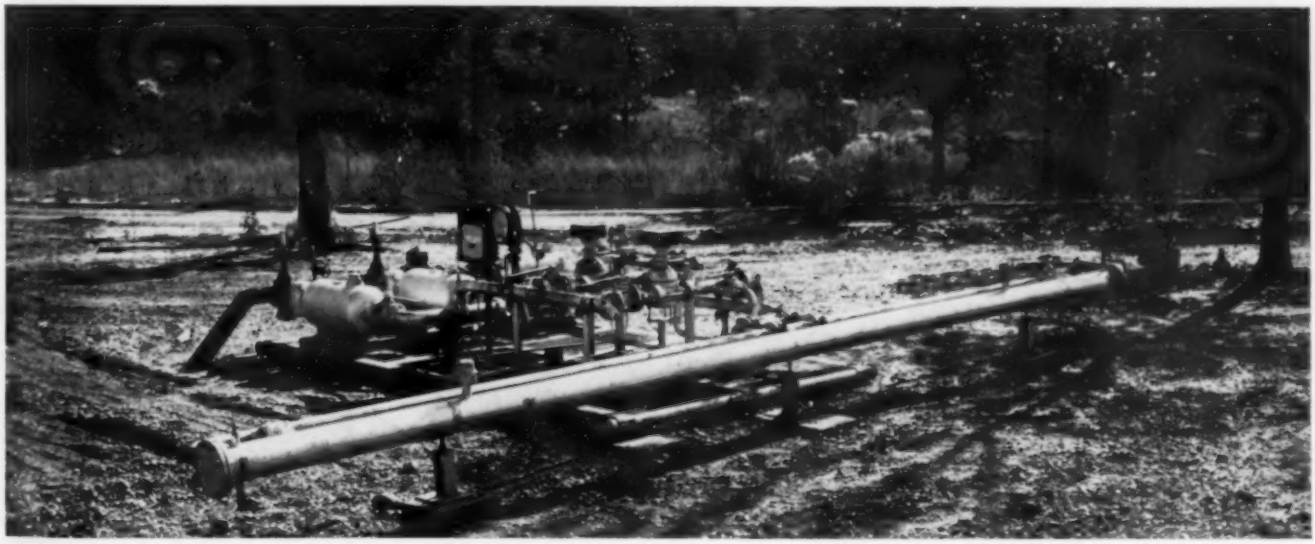

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The Pipe Line Custody Transfer installation shown above is equipped with Dual S-24 Smith Meters that are proved "on the run" at operating pressure and flow rate.

No pump or stand-by capacity is required. The stream is merely diverted through the prover barrel and meter factors are obtained in a matter of minutes.

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Good News for

Good news for oil and gas men: another mill is born for seamless tubes and pipes up to 10¾-inch outside diameter. It will provide a new source of all grades of steel pipe.

The plant is located in the Seine valley at Deville-les-Rouen, on the outskirts of Rouen. The vast modern mill is part of the SIDELOR Company, which is in turn an important division of PONT-A-MOUSSON, a major world-wide holding Company, in the iron and coal mining, steel and steel pipe industries. In steel production, PONT-A-MOUSSON has an annual capacity of 5 million tons.

Its extensive manufacturing complex makes PONT-A-MOUSSON one of the largest European steel pipe resources. PONT-A-MOUSSON offers a full range of pipeline products for the oil and gas industry. In addition to its subsidiary plant at DEVILLE, it also directs operations of the Belleville plant in eastern France which produces large diameter welded steel pipe.

In addition, PONT-A-MOUSSON directs the Differdange plant in Luxemburg, manufacturing small and average diameter steel pipe; it also controls a number of pipeline installation companies with a capital equipment investment of 10 million dollars. Another subsidiary, the Ludwigshafen plant in Germany manufactures oil pumps.

These recently constructed plants have enabled PONT-A-MOUSSON to play a key role in the development of oil and gas deposits at Lacq and in the Sahara. Pres-

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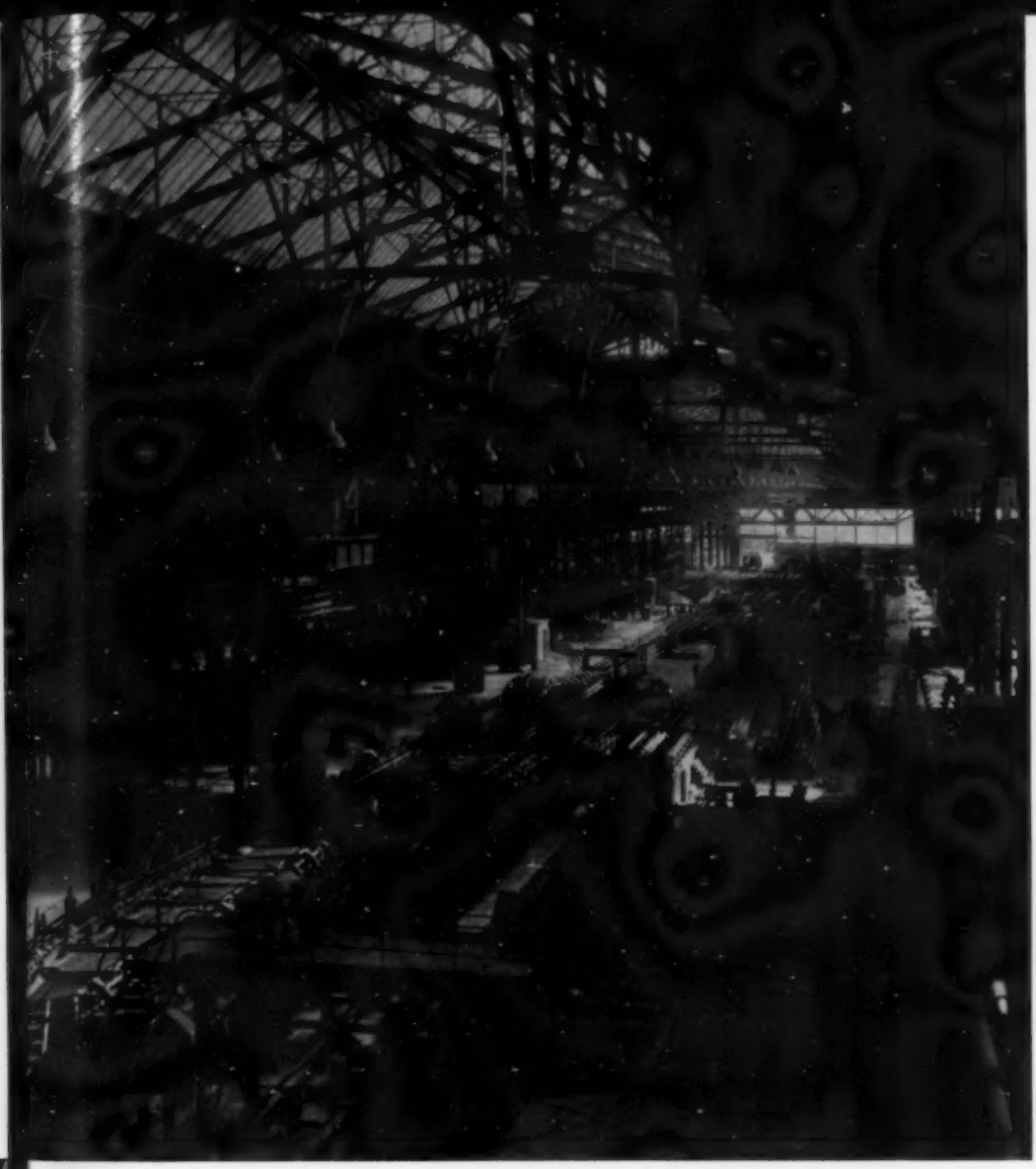


Oil and Gas Men

ently, the firm is heavily engaged in the construction of the sub-European pipeline which will connect the Mediterranean port of Marseilles with Karlsruhe in West-Germany.

The new mill in Deville-les-Rouen has been designed primarily to supply and serve the petroleum industry, both at home and abroad. The Company intends to export roughly 50 percent of its production. Pipes and tubes from ⅓ of an inch to 10¾-inch O.D. in every grade of steel are now being manufactured in Deville-les-Rouen, including P-110. This pipe has received the API label. Casing and tubing of various sizes and grades now is being shipped to users around the world.

Deville-les-Rouen also has supplied large tonnages of pipe for the Sahara, the new booming oil province of North Africa. The mill also is a leader in supplying high grade steel pipe, especially designed for the sub-Mediterranean pipeline, which will carry gas from the enormous Hassi-R'Mel field in the Sahara to Europe.

Patterned after three of the latest and most modern seamless tube and pipe mills in the United States, the Deville-les-Rouen mill is by far the most advanced in Europe. Plant equipment has either come from the United States or was constructed in Europe under American licenses.

Its most important element, the fully-automated plug-rolling-mill, has been installed by Aetna-Standard. Its flexibility, capacity and varied production range enable it to supply widely variable European demands. A monthly production rate of 10,000 to 15,000 tons at Deville-les-Rouen is planned.

The plug-rolling-mill is supplied from a giant rotary hearth furnace which turns out a 2,320° F, 3,300 pound, 16-foot long steel billet every 20 seconds.

The red hot solid steel cylinder then starts a rapid 1,000 foot course which transforms it into steel pipe in less than five minutes. The five basic operations involved are as follows:

From the furnace, a centering machine marks the billet, which is then pierced by a shell-shaped piercer point. Turning rapidly on itself, the billet is then elongated into tube form, and enters the two-stage rolling phase. Reeling, reducing and sizing operations follow. The tube then enters the finishing oper-

(Advertisement)

ation. The modern finishing shop provides production in strict conformity with American and European specifications. In this shop, the tube is straightened, cut and hydrostatically tested to 13,000 PSI.

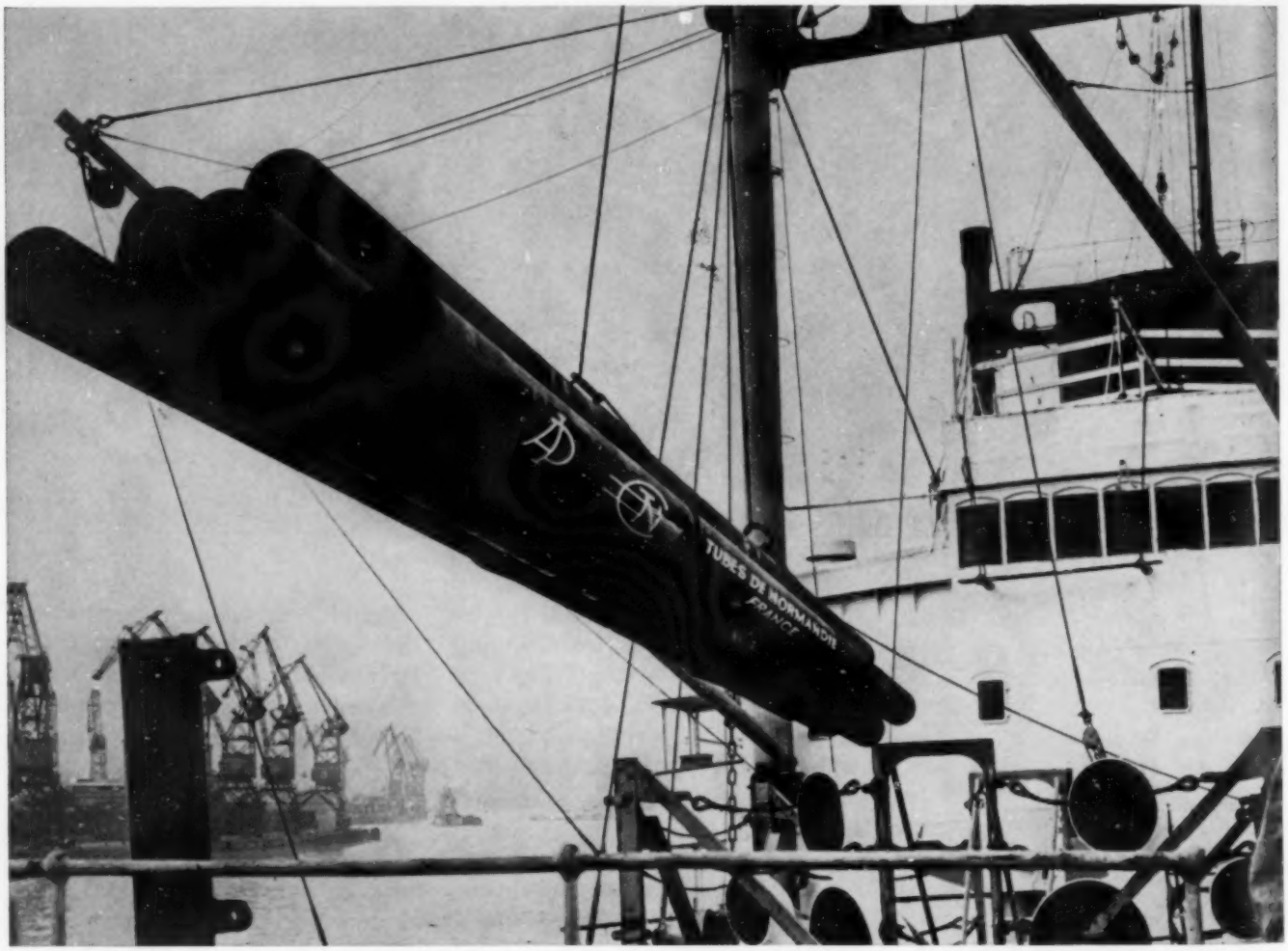
According to final use or destination, the tube might also go through a threading operation.

Other special operations available include upsetting, heat-treatment, quenching and tempering. Production is controlled by Moody Engineering, a widely-known American firm, and quality control is maintained at high level. The French Company also maintains an agreement with the National Supply Company, for technical assistance and exchange of information and experience.

The mill represents an investment of $30 million. Machinery and equipment valued at $7.5 million has come from the United States or was produced under American license in France.

From the beginning, operations have been supervised by American expert F. W. BREMMER of Pittsburgh, formerly of National Supply and now a Consulting Engineer. His knowledge and experience have earned high commendation from Management. Says Engineer BREMMER: "Since this plant is as good as any of the latest installed in the U.S., we can compete with any one in the world from the point of view of quality."

For oil and gas men knowing exactly what they want in high standard pipe products at low cost, BREMMER'S is confident recommendation is to look to the Seine Valley and its newest industrial giant.



PONT-A-MOUSSON

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repair products in these areas.

Castle formerly was district manager for Lincoln Engineering, Inc.

Southwest Industries, Inc. Named AiResearch Distributor

Southwest Industries, Inc., has been named an exclusive distributor for a line of turbocharger equipment of AiResearch Industrial Division. The company will handle all sales and installation of turbochargers for two-cycle natural gas engines in a 12-state area. The states include Texas, New Mexico, Colorado, Nebraska, Kansas, Oklahoma, Louisiana, Mississippi, Alabama, Arkansas, Missouri, and Illinois.

W. W. Leonard

D. W. Kelly

Colorado Fuel & Iron Names Leonard Tubular Sales Manager

W. W. Leonard has been named manager and D. W. Kelly becomes assistant to the manager of tubular sales for the Colorado Fuel and Iron Corporation. Leonard has been with the company since 1952 and Kelly joined CF&I in 1955.

CompuDyne Electronics, Inc. Names Bernstein General Manager

Jack H. Bernstein has been appointed general manager of CompuDyne Electronics, Inc. He had been with Stromberg-Carlson Division of General Dynamics as production superintendent.

Byron Jackson Enlarges Hydraulic Test Facilities

Byron Jackson Pumps, Inc., has increased test motor capacity to a total of 17,500 hp in a major expansion of hydraulic test laboratory facilities. Facilities are used for testing centrifugal pump designs. With new additions, total area of plant is 153 by 60 feet.

Dynel, Inc., Appoints Dickinson General Manager

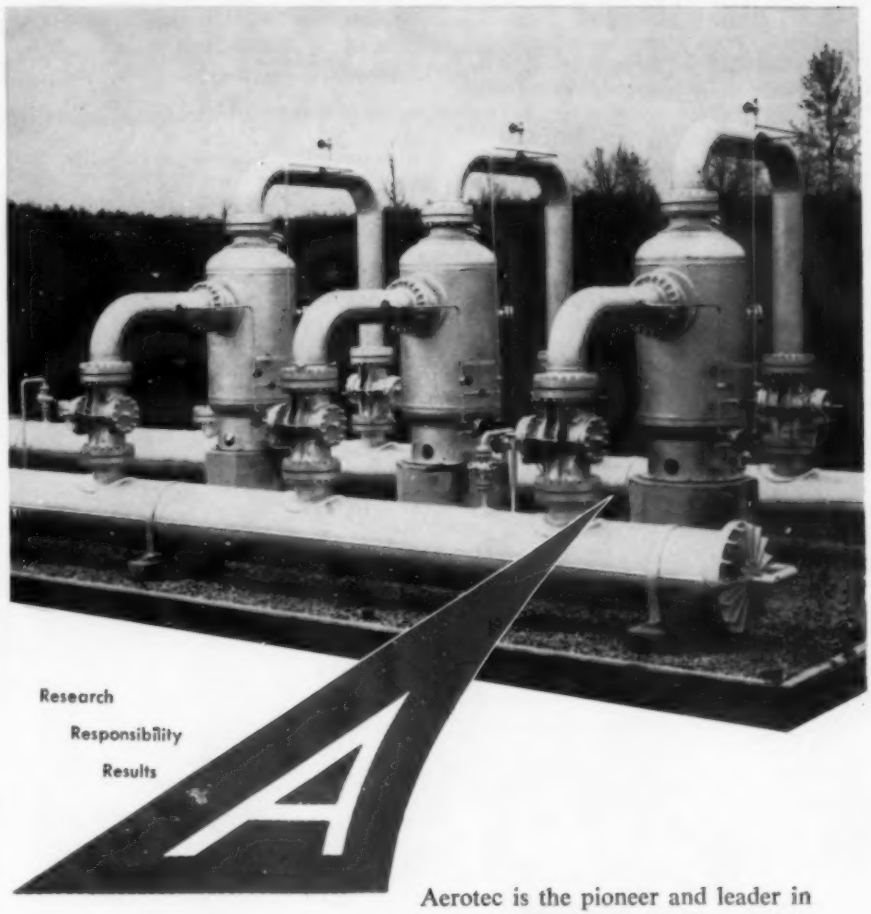
H. Dickinson has been named general manager of Dynel, Inc., a subsidiary of Varec, Inc. Dickinson joined Varec in 1951 and was named vice president in 1959 and a director in 1960.

Dunwoody Pipe and Supply Announces Expansion Plans

Dunwoody Pipe and Supply Company plans expansion of operations including a series of supply stores in strategic areas. The first such store is operating in Houma, La., with Gordon Lockett named manager.

Lynch Communication Systems Promotes Shisler to Manager

David Shisler has been named manager of application engineering for Lynch Communications Systems, Inc. He joined Lynch in 1953 and had been manager of the company's inside sales department.



AVOID TROUBLE

profit by AEROTEC'S long experience with DRY GAS SCRUBBERS

Aerotec is the pioneer and leader in dry centrifugal gas scrubbers. Their units are world-renowned for constant pressure drop — no oil carry-over — high efficiency. Developed in close cooperation with the gas industry more than 17 years ago, the units' advantages stated above have been verified by the A.G.A. (Proj.NFX-12 Report).

Today, Aerotec dry centrifugal gas scrubbers are the focal point of attention by other manufacturers interested in centrifugal-type scrubbers. But the marked dependability and efficient operation of Aerotec units are the result of the more than 35 years experience in design and development of every type of centrifugal collector. This background and continued research is your assurance of trouble-free operation. Why not buy experience . . . it pays.

For Catalog AI-102 on Gas Scrubbers, write: Industrial Division, Aerotec Industries, Inc., Dept. I, Greenwich, Conn. In Canada: T. C. Chown Limited, Montreal, Toronto.

AEROTEC INDUSTRIES, INC.
INDUSTRIAL DIVISION

Other Divisions: **AIRCRAFT EQUIPMENT** Electro-Mechanical for the Aircraft, Missile and Nuclear Industries
AEROTHERM Aircraft Lounges, Passenger and Crew Seating

For more data on advertised products, use cards, last page.

Electrodynamic Instrument Establishes Pipe Line Department

A new process automation division has been announced by Electrodynamic Instrument Corporation. The division will design and supervise installation of process automatic systems for pipe lines and plants. J. C. Stilley of Houston becomes manager of the division.

Tinker & Rasor Names Byerley Division Manager

Darrel D. Byerley has been named general sales manager of Tinker & Rasor's newly acquired Detectron Division. He had been field sales manager for Tinker & Rasor.

Pipeline Testing Division Formed by Brine Service

Brine Service Specialties, Inc., has formed a new Houston based division. Pipeline Testing Division of Brine Service Specialties, Inc. Vice President W. D. Schoolcraft will head the new division.

Hoyt Named Staff Assistant For TRW Computers Company

Emerson M. Hoyt has been appointed staff assistant to director of engineering for TRW Computers Company. Prior to joining the company, Hoyt had been with Systems Integration Staff of the Systems Division of Bendix Corporation.

Collins Radio Company Expansion Completed

Collins Radio Company has completed expansion projects on its Dallas area facilities. One project costing $1.8 million is a manufacturing building with 117,000 square feet of space. The other building is a 24,000 square foot antenna research structure costing over $500,000.

Continental-Emsco Appoints Philip Liston Sales Manager

Philip J. Liston has been appointed sales manager of the Fibercast Company. Formerly assistant sales manager for Fibercast, he has been with the Continental-Emsco Company since 1957.

Crane Names Sonio Coletti Assistant Sales Manager

Sonio E. Coletti has been appointed assistant sales manager for Cie Crane, French affiliate of Crane Co. Coletti will be headquartered in Paris.

J. A. Bailey Appointed LACT Sales Supervisor

Jones & Laughlin Supply Division named James A. Bailey sales supervisor—LACT in the production equipment sales section. He has been with the company since 1959.

Clark-Roots Connersville Los Angeles Office Moved

Clark Brothers Co., and Roots-Connersville Blower, have relocated in Los Angeles. Company offices have moved to 5915 E. Sheila St., Los Angeles 22.

Thomson Electric Names Brandt Vice President

Frank L. Brandt has been appointed a vice president for the Lynn Division of Thomson Electric Welder Co. His responsibilities will be in sales, engineering and production of resistance welding equipment.

TOGETHER FOR GOOD

Reilly Coal Tar Enamels and related primers, used together, provide the corrosion protection needed by underground metal structures. The Reilly hot enamel system is:

electrically insulated	oxidationproof
waterproof	stressproof
oilproof	tough and strong
bacteriaproof	permanently bonded

In addition, Reilly coating systems offer ultimate longevity because they inherit the chemical inertness and stability of coal tar, from which they are made.

Specify Reilly hot-applied coal tar enamels and related primers for oil, gas and water pipelines.

REILLY ENAMEL AND PRIMER

Reilly Pipeline Enamel	Reilly Pipeline Primer	Reilly Redhead® Primer
Reilly Intermediate Enamel	Reilly QD Primer	
Reilly 230-A Enamel	Reilly 230 X-10 Primer	
Reilly 230 AWWA Enamel	Reilly 230 X-10 Primer	
Reilly Hot Service Enamel	Reilly 230 X-10 Primer	

REILLY TAR & CHEMICAL CORP.
1615 MERCHANTS BANK BUILDING, INDIANAPOLIS 4, INDIANA

Reilly COAL TAR PRODUCTS
ARMOR Protective Coatings

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, JULY 2, 1946 AND JUNE 11, 1960 (74 STAT. 208) SHOWING THE OWNERSHIP, MANAGEMENT AND CIRCULATION OF PIPE LINE INDUSTRY, published Monthly at Houston Texas for October, 1961.

1. The names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Wm. G. Dudley, 29 East Shady Lane, Houston, Texas; Editor, Melvin A. Judah, 3271 Sul Ross—Apt. 1, Houston, Texas; Managing editor, Wallace Fitzgerald, 5423 Lymbar Drive, Houston, Texas; Business manager, Robert M. de Sombre, 4410 Ingersoll, Houston, Texas.

2. The owner is: The Gulf Publishing Company, Houston, Texas; June Wooden Bliss, Houston, Texas; June Wooden Dudley Bliss—Trustee, Houston, Texas; Mrs. Grace C. Carter, Dallas, Texas; Margaret Dudley Cashman Trust, Houston, Texas; Drum & Company, c/o Trust Department, Houston, Texas; Fredrica Gross Dudley, Houston, Texas; P. Stinson Dudley, Abilene, Texas; Estate of Ray L. Dudley, Houston, Texas; William G. Dudley, Houston, Texas; William V. Gross, Austin, Texas; Carolyn Dodson Keeble, Abilene, Texas; Anita S. Lane, Houston, Texas; James William Nelson, Baytown, Texas; Tom W. Nelson, Houston, Texas; Obie & Company, Houston, Texas; Sallie Windham Ridley, Corpus Christi, Texas; Walter Gage Sterling, Trustee, Houston, Texas; Edna C. Waller, Chicago, Illinois.

3. The known bondholders, mortgagees, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: NONE.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other that that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: 6,248.

R. M. de SOMBRE
Business Manager

Sworn to and subscribed before me this 4th day of October, 1961.

P. J. AUCOIN
(Seal) Notary Public in and for Harris County, Texas.
(My commission expires June 1, 1963)

IN CORROSION PREVENTION

BITUMASTIC
reg. U. S. Pat. Off.
HOT & COLD APPLIED COATINGS

Carey
PIPELINE FELT, PADDING & GLASS PIPE WRAP

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PRESET AUTOMATICALLY TIMED

PUMP CONTROLS

FOR GASOLINE, DIESEL & GAS ENGINES

for

OIL WELL & PIPE LINE PUMPING

Synchro-Start's Program timer control can be PRE-SET for the LENGTH OF TIME, TIME OF DAY OR NIGHT and the DAYS OF THE WEEK the engine is required to RUN, as well as the time it is to be stopped.

Incased in a steel, weather proof cabinet it contains a standard Synchro-Start Automatic Engine Control together with a timer driven by a governed D.C. motor. No commercial power is required as all current is taken from the engine battery.

SYNCHRO-START PRODUCTS, INC.

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high frequency, resistance welded

Authorized by A.P.I. under Std. 5L and 5LX where applicable

The API monogram on Valley lightwall pipe means highest quality, because Valley pipe meets the standards of the American Petroleum Institute.

Closer and more convenient, too! Valley has the only pipe mills in the Great Plains—500 miles closer to midwestern and Rocky Mountain oil and gas fields.

Sizes 6 5/8" to 16" Wall Thickness to .219

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VALLEY, NEBRASKA

WEKSLER INSTRUMENTS
BI-METAL DIAL THERMOMETERS
ACCURACY: Within 1%
MATERIALS: 18-8 Stainless Steel, welded joints
WORKMANSHIP: The finest, right through to individual calibration
COST: Being Weksler, cost is always moderate

Weksler Bi-Metal Dial Thermometers are incomparable for every type of scientific temperature measurement. Dished anti-parallax dials, stem lengths to fit all standard thermo-wells, gasket sealed bezels, heavy crystal, external adjustment, and all standard F and C ranges are features you expect and get from Weksler!

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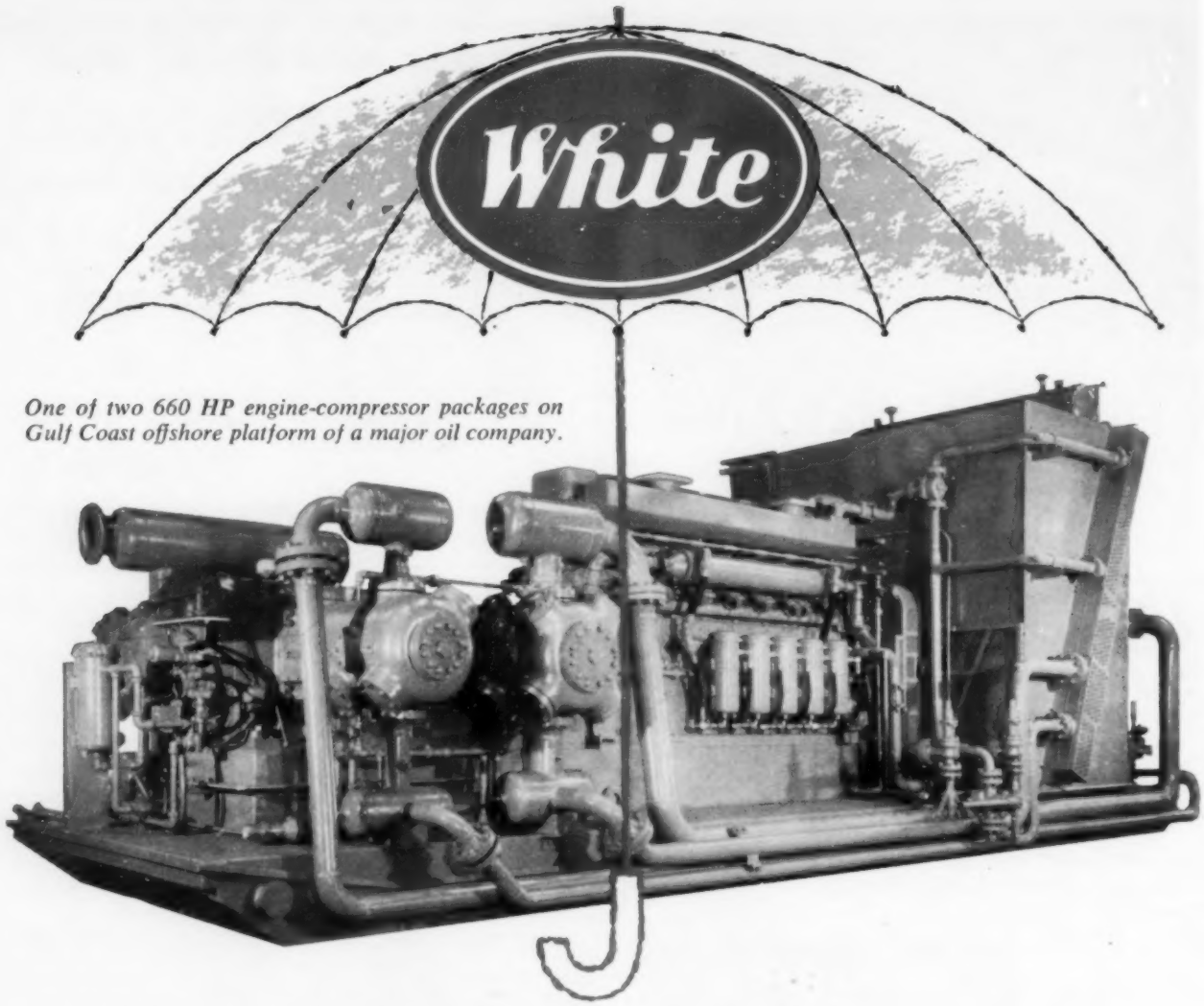
WEKSLER INSTRUMENTS
"ORIGINATORS OF WORLD RENOWNED ADJUST ANGLE THERMOMETERS"

WEKSLER INSTRUMENTS CORPORATION

195 EAST MERRICK ROAD, FREEPORT, L. I., N. Y.

Indicating and Recording Instruments for Temperature, Pressure and Humidity



One of two 660 HP engine-compressor packages on Gulf Coast offshore platform of a major oil company.

White's single responsibility covers Engine and Compressor ALL THE WAY

White-Superior 200/1000 BHP Compressors are designed for exact match with Superior *medium speed* gas engines. Both units are precision built to identical standards at White in Springfield. White therefore assumes *complete and undivided responsibility* for all vital parts on its direct-driven, balanced opposed engine-compressor sets.

Single responsibility *all the way* starts with pre-engineering (selecting the right combination for your job) . . . extends through manufacturing, the installation alignment check-out and start-up. White also provides on-the-job training of your personnel for proper operation and maintenance of complete unit. You'll find factory service and parts readily available from White's extensive field service organization.

Two, four and six-cylinder, single or multi-service compressors are available properly packaged (see list) and ready for service. For engineering assistance or Bulletin 124, contact nearest White representative or write today to White Diesel Engine Division, Springfield, Ohio.

White DIESEL | Superior ENGINES

White Diesel
ENGINES / COMPRESSORS

WHITE'S AUTHORIZED PACKAGERS

West Coast	Guy T. Martin & Co., Inc.
Rockies	Stearns-Roger Mfg. Co.
Mid-Continent	Southwest Industries, Inc.
Canada	Southwest Barber, Ltd.
Canada	Stearns-Roger Engr. Co., Ltd.

Controls Schools at SIE Division

Modern control technology in pipe line industry was the curriculum for a week-long course given these 24 pipeliners at Dresser Electronics, SIE Division, Houston. All phases of solid state and digital principles as applied in pipe line controls, ranging from elementary control concepts to applied logic were discussed. Attendees included, first row, left to right, Antone Kozola III, Mountain Fuel Supply Co.; Jeff C. Campbell, Dresser Electronics; Bruce Erickson, Nordberg Manufacturing Co.; Robert W. Smith, Jr., Gulf Interstate Company; Jose Gomez S., Petroleos Mexicanos; G. R. McEathron, Tennessee Gas Pipeline Company; Grant Brown, Mountain Fuel. Second row, left to right, Hugh A. Saye, Jr., and A. H. McMorris, Dresser; J. L. Pool, and J. W. Patterson, Magnolia Pipe Line Company; F. A. Schmidt, Tennessee Gas Pipeline; James J. Morris, Colorado Interstate Gas Company; R. H. Echols, Atlantic Pipe Line Company; Raul Meyer S., Pemex; G. G. Goelz, Nordberg; T. E. Brown, Magnolia. Third row, left to right, John Tittle, Brown & Root, Inc.; James R. Waller, Jr., and Harvey Ammerman, Magnolia; J. W. Jervis, Continental Pipe Line Company; R. G. Smith, Magnolia; F. Alan Wheeler, Colorado Interstate; J. D. Guidry, Gulf Refining Co.; W. A. Fryters, Mobil Oil of Canada; John J. Sonnier, Shell Pipe Line Corporation; and John T. Manry, Sr., Dresser.

BOOKS

Branch Connections Report 2: Survey of Research, American Gas Association, 420 Lexington Ave., New York 17, N. Y., $2.

This engineering report outlines recommendations for the elimination of high stresses in gas pipe line branch connections.

The report, prepared by Battelle Memorial Institute, summarizes all available data from published and unpublished works to determine the present level of knowledge concerning gas transmission and distribution branch connections research. The publication reviews experimental stress analyses of more than 70 connections.

Federal Power Commission Reports, Volumes 19 and 20, U.S. Government Printing Office, Washington 25, D.C.

The Federal Power Commission has issued Volumes 19 and 20 of the FPC reports, opinions and decisions. Volume 19 ($4) contains opinions, decisions, and orders of the commission issued during the first six months of 1958 and Volume 20 ($3.50) contains those of the last six months of that year.

Volumes 1 through 20 have been published and cover years from 1931 through 1958.

Compressed Air and Gas Handbook, Compressed Air and Gas Institute, Cleveland 13, Ohio, 592 pages, $8.00.

The third edition of the handbook covers all phases of the compressed air or gas industry. Data is presented in curves or tables, whenever possible. It includes sections on maintenance schedules, lubrication, starting up of new compressors, design, construction, plant layout and industrial engineering.

The book includes 323 illustrations and tables and graphs are used as far as possible; the text is indexed and cross referenced to assure its usability.

Standard Welding Terms and Their Definitions, American Welding Society, Dept. T., 33 West 39th Street, New York 18, N.Y. $2.00

The American Welding Society has issued a revision of its AWS standard welding term and definitions. It's the first revision in 12 years and many changes are incorporated and much new material added.

A new Master Chart of Welding Processes has been prepared in conjunction with the definitions. Welding processes are presented in a new layout designed for ready reference.

CLASSIFIED ADVERTISING

■ TRADEMARK and lettering decals made for your trucks, equipment, small quantities or more. Write for Catalog. Mathews Co., 827 S. Harvey, Oak Park, Ills.

■ PROJECT ENGINEER, Pipe line design and construction. Desires a permanent position in Houston, Texas area. In lieu thereof will accept temporary assignment within the United States. Fifteen years experience. Graduate mechanical engineer, Rice University. Box 57, PIPE LINE INDUSTRY.

Manuscripts Wanted

Have you written a book you would like to have published? Do you have an idea or an outline that you would like to talk over with a publisher? Gulf Publishing Company, publishers of World Oil, Hydrocarbon Processing & Petroleum Refiner and Pipe Line Industry magazines, and numerous technical books, is actively seeking trade and technical manuscripts for publication by its rapidly expanding Book Division. For further information write to Manager, Book Publishing, Gulf Publishing Company, P. O. Box 2608, Houston 1, Texas.

SKINNER-SEAL

PIPE JOINT CLAMP STOPS LEAKS

at joint where pipe is screwed into fitting

SKINNER-SEAL

PIPE JOINT CLAMP stops leaks at joints where pipe is screwed into fitting. Any temperature—any pressure up to 2,000 pounds. Saves the cost of tearing out and renewing leaky fittings. Prevents shutdowns. In stock at most oil supply stores.

SKINNER-SEAL

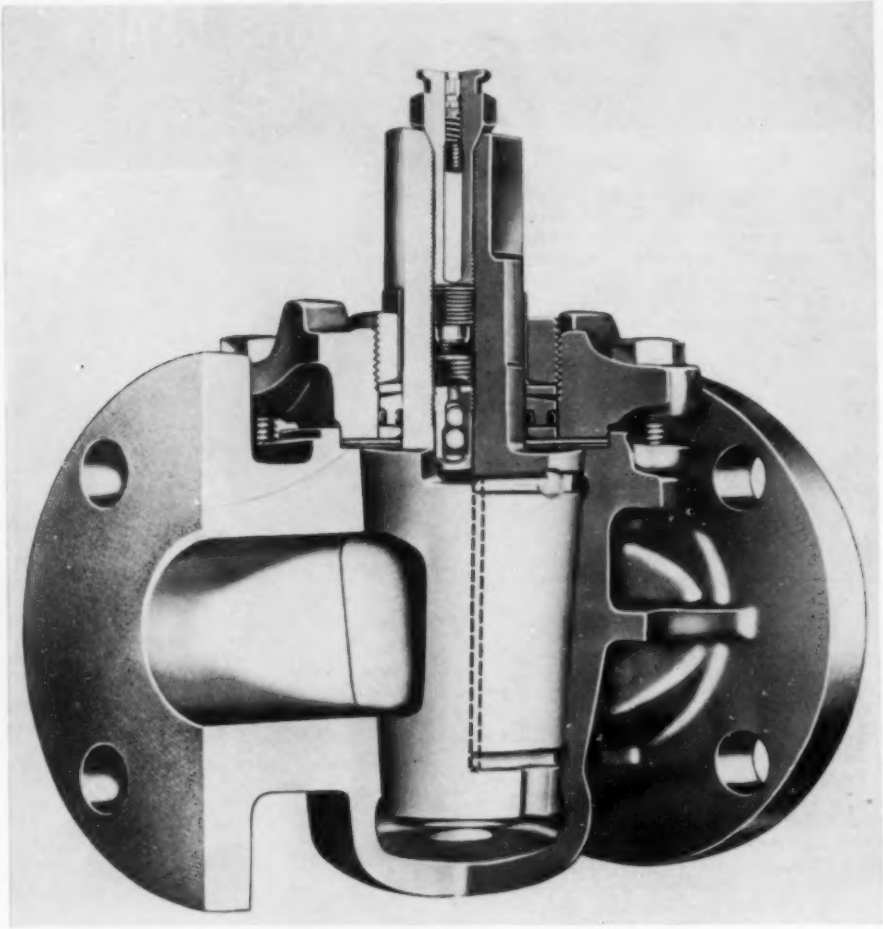
EMERGENCY PIPE CLAMPS for safe, sure, lasting repair of splits and rust holes in pipe. No pressure too high. Anyone can apply in a few moments. Made in all sizes, ½" to 12" for steel and C.I. pipe. Stocked by practically all oil supply stores.

Complete line of Repair Clamps. Send for Catalog 54!

M. B. SKINNER CO.

SOUTH BEND 21, INDIANA

What's New in EQUIPMENT



Rockwell Unveils Permaturn Valves

The new tapered plug valves, the Rockwell Permaturn, are designed to handle services ranging from jet fuels and chemicals to water and sewage.

Valve features a high lubricity plug coating of about 0.0005-inch applied to tapered surfaces. For low pressure Permaturn valves, up to 1,000 psi, the coating is teflon, a polyfluoride thermoplastic with an extremely high softening point. For high pressures, up to 10,000 psi, valves are coated with phosphate-molybdenum disulfide. Both coatings are permanently bonded to the metal surfaces of the tapered plugs.

The valves also feature single, quarter-turn operation which allows full opening and closing with one 90 degree turn; easy seat replacement by an injection of Rockwell sealant while valve is in operation; and sealant pressure maintained by double ball checks in enclosed grooving system in both plug and body to prevent back pressure on sealant chamber.

Rockwell has adopted the Permaturn name to replace the Rockwell-Nordstrom name that designates the company's line of tapered plug valves.

In field tests the valves have been used in applications ranging from natural gas and ammonia to molten sulfur and jet fuel. A utility company tested the valve for 500 cycles on gas service at 120 pounds inlet pressure. It has been tested on jet fuel lines at a midwestern airfield and in other installations.

Valves are available in ¼ to 36-inch sizes in all standard pressure ratings. For pressures up to 1,000 psi WOG, Permaturn is made in standard design; for higher pressures up to 10,000 psi WOG, the inverted Hypreseal design is recommended.

(This item supplements Rockwell Manufacturing Company data on pages 381-412 of the Pipe Line Catalog, Third Revision).

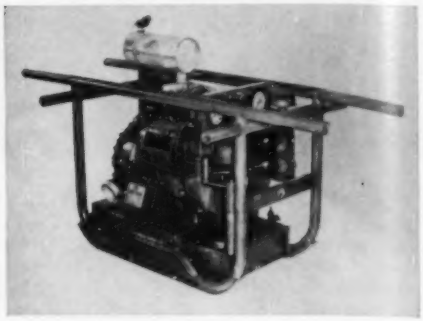
For more data, circle **No. E1** on Readers' Service Card, last page this issue.

Station Antennas

Motorola, Inc., announces a new line of folded coaxial design base station antennas for 136-174 mc two-way radio systems. Three series included are omnidirectional (TAD 6070), cardioid (TAD 6080) and unidirectional (TAD 6090).

All three utilize center-fed half-wave design with a folding radiating element and a coaxial skirt section. This design eliminates projecting ground plane rods to simplify installation, reduce pattern distortion and minimize ice damage in cold climates.

For more data, circle **No. E2** on Readers' Service Card, last page this issue.

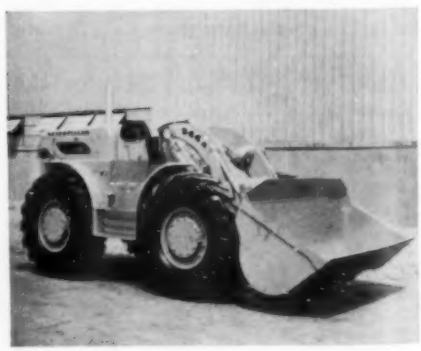


Pressure Governor

Santa Fe Manufacturing Corp. has developed a hydraulic pressure governor and differential pressure controller for pipe line pumping units. The controller senses upstream and downstream pressure conditions and provides for instantaneous corrective action by adjusting pump speed through carburetor throttle setting of the gasoline engine. It idles engine when maximum discharge or minimum suction pressure is reached and shuts off the engine when maximum discharge or minimum suction pressure is exceeded. The governor allows on the spot setting of required pressure conditions.

Governor derives power from pipe line pressure—upstream and downstream. It is designed for mounting on the side of the pump with governor connected directly to engine carburetor. It is actuated by pump suction and pump discharge pressure. If these pressures fail, a fail-safe devise will idle the pump.

For more data, circle **No. E3** on Readers' Service Card, last page this issue.

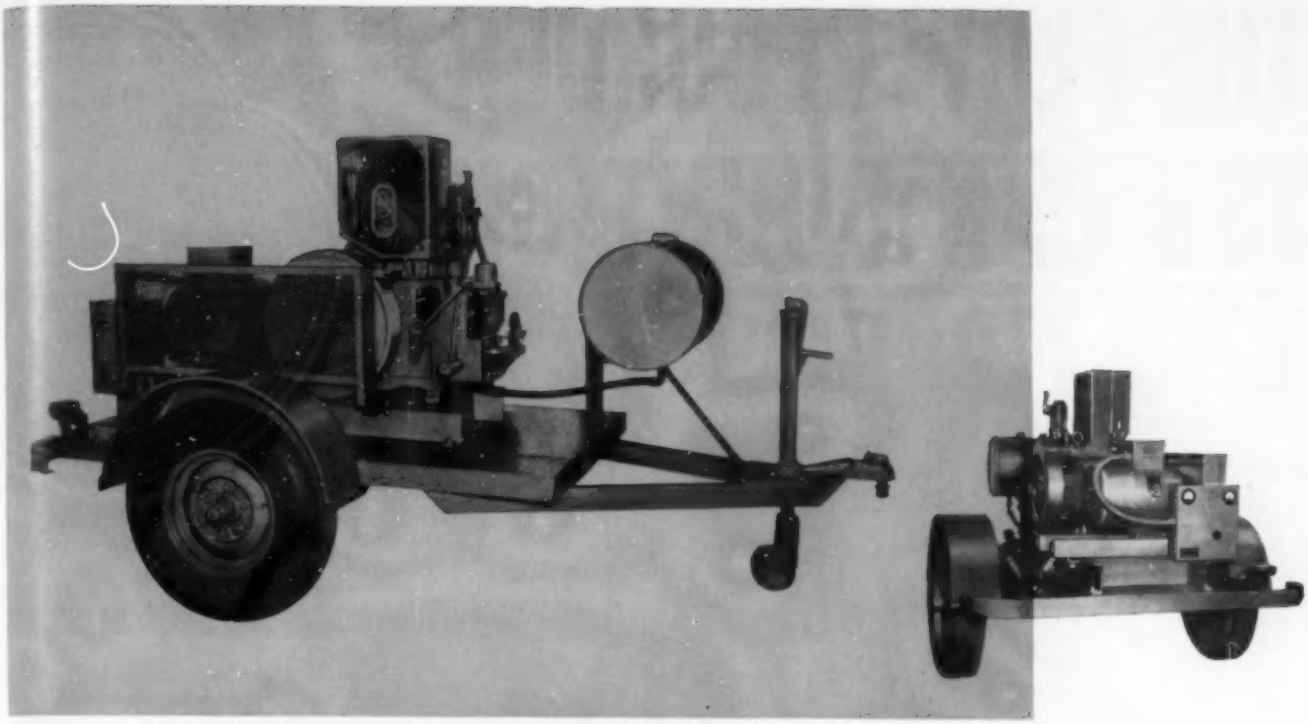


Bucket Additions

Caterpillar Tractor Co. announces nine new general application buckets, three types for each of three models. Buckets incorporate new extended cutting edges. Induction hardened, edges are self-sharpening to retain good penetration throughout their service life. Holes for mounting bucket teeth adapters are pre-drilled in buckets of the types normally used for excavation work.

(This item supplements Caterpillar Tractor Co., data on pages 66-69 of the Pipe Line Catalog, Third Revision.)

For more data, circle **No. E4** on Readers' Service Card, last page this issue.



Witte's 98RBD trailer-mounted engine-generator unit has a standard 3 KW DC shunt-wound generator in a wide speed range from 750 to 1800 rpm.

Witte 98RBD Cathodic Protection Unit enables you to offer pipeline customers another profitable service!

Here is a heavy-duty, highly mobile, cathodic protection unit that will enable a pipeline contractor to provide an added service to his customers. This engine-generator unit will afford him an opportunity of recommending and furnishing the necessary amount of protection when the pipeline is installed.

It is a known fact that a corroded pipeline cannot be restored, but corrosion loss can be stopped if cathodic protection steps are taken in the early stages of a pipeline installation.

Witte's 98RBD is built especially for this type of continuous operation. The heavy-duty oilfield-type gas engine has been thoroughly field-tested. It has a low center of gravity, is well-balanced, and every part is easily accessible. The engine has condenser cooling, removable wet cylinder liners, and roller main bearings. It is equipped for long-run service, having oil make-up reservoir and float valve as well as lube oil and cooling water safety controls.

These trailer-mounted units have a 32-40 volt, 3 KW generator in a wide speed range from 750 to 1800 rpm. They are V-belt driven, with a voltage control to less than 5 volts when the generator speed is 750 rpm.

Complete information on both the standard and trailer-mounted Witte gas engine-driven generator units is available through oilfield supply stores.

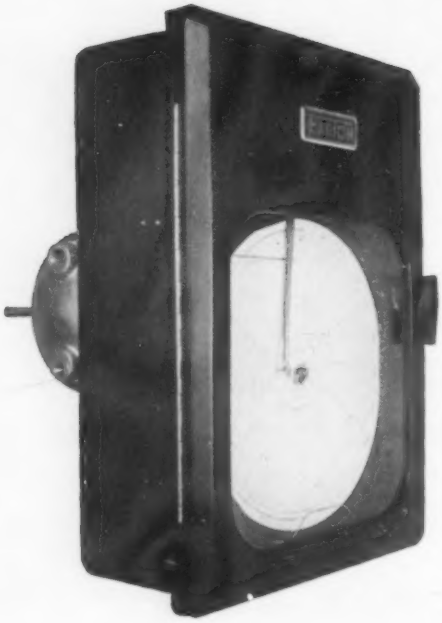
USS and Witte are registered trademarks

USS

Witte Engine Works
Oil Well Supply
Division of
United States Steel

Offices and Plant: Kansas City 26, Missouri

THE FLOW RECORDER YOU CAN COUNT ON

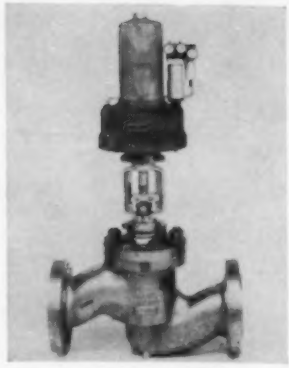


Absolute dependability, under the most demanding operating environments—that's the promise and the performance of the Barton 202A flow recorder. Thoroughly proven in the gas production fields, the 202A is enjoying ever-increasing popularity in gas transmission and distribution systems. It is compact and ruggedly built, not subject to the usual frailties of such a precise instrument; it has built-in overrange protection, and it is immune to condensate problems, making it ideal for application in all geographical areas. A recently added bonus: the 202A can be fitted with the new Barton chart changer which allows the instrument to record continuously and unattended, for up to 16 days, using a fresh chart each day. For complete information and specifications on the 202A flow recorder, request Bulletin 202A-1.

BARTON®

RECORDER-INTEGRATORS/CONTROLLERS/DIFFERENTIAL PRESSURE INDICATORS/PNEUMATIC TRANSMITTERS/FLOW SWITCHES

BARTON INSTRUMENT CORPORATION • MONTEREY PARK, CALIFORNIA



Valve System

A high precision electro-hydraulic valve system, complete with integral electronic control systems has been developed by Security Valve Company. The valve is available in all ASA sizes and ratings. System also has electro-hydraulic actuator and an electronic controller which provides the signals to operate the valve and necessary system equalization and associated transducers.

The electronic controllers were developed in conjunction with Micro Gee Products Inc., an affiliated company.

For more data, circle **No. E5** on Readers' Service Card, last page this issue.

Digital Converter

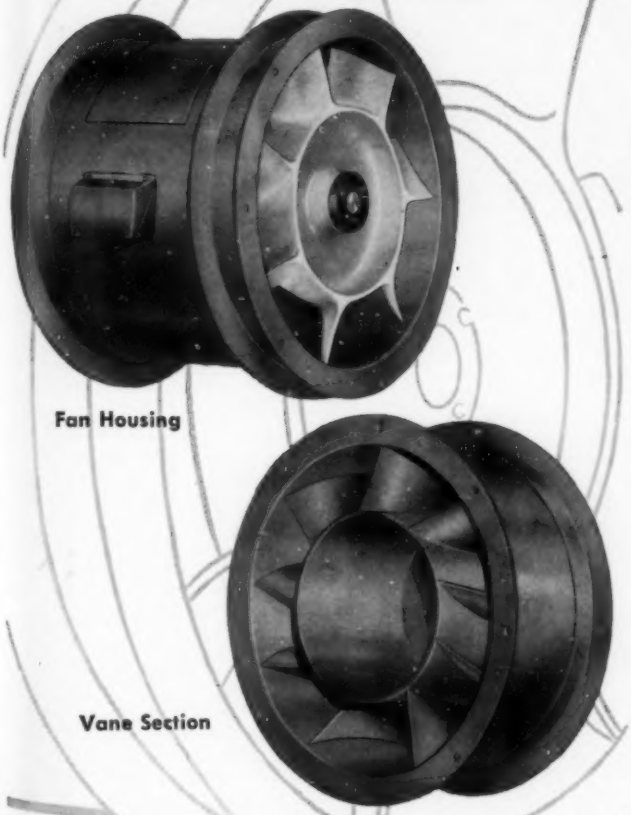
A new digital scanner and converter which reads dial and pointer instruments, gages and meters and provides a remote digital output has been introduced by MacLeod Instrument Corporation. The DISCON applications include pressure gages, flowmeters, thermometers, electrical meters, liquid level gages, tachometers, and mechanical dial indicators.

Instrument dials from 3 to 20 inches in diameter can be accommodated. The device can be used as a simple deviation alarm or upset indicator to read out on a change of static condition with hi-lo-go units. Operating photoelectrically, the scanner unit "bridges" the existing instrument dial and mounts outside the instrument flange. There is no electrical or mechanical attachment required to the instrument to be scanned; therefore fully pneumatic or mechanical meters can be read.

For more data, circle **No. E6** on Readers' Service Card, last page this issue.

another outstanding design development from

Aerovent



direct-connected

vaneaxial fans

with removable vane sections

Engineered for high-pressure, high-velocity air distribution systems, these units feature a unique removable vane section which simplifies installation and permits easy access for routine cleaning and maintenance.

Available in 30 models in sizes 18″ to 48″ for capacities from 3230 to 67,300 cfm with special design features for all application requirements.

Write for Bulletin 475

Air deliveries of all Aerovent equipment are tested and rated in accordance with established and accepted codes and each unit is guaranteed by the manufacturer to deliver its rated performance.

CERTIFIED PERFORMANCE

Aerovent

FAN COMPANY, INC.

ASH AND ROTH STREETS PIQUA, OHIO

PLIDCOFLANGE
PLIDCOFLANGE
PLIDCOFLANGE

...NO OTHER PIPE FITTING DOES SO MANY JOBS SO WELL

Designed for fast, easy installation plus economy

Plidcoflange applications are practically limitless. This versatile pipe fitting may be welded permanently to the pipeline, without shutting down, or bolted in place for future removal.

Plidcoflange slips over end of pipe, mates up with standard flange facings. No flange spreaders, jacks or bars required. Ideal for use as a blind plate flange. Just slide Plidcoflange back to change plates.

Plidcoflanges are available in standard sizes 2″ through 12″ with 150 lb. A.S.A. steel flanges. Other sizes and pressure classes on request. Send for illustrated brochure.

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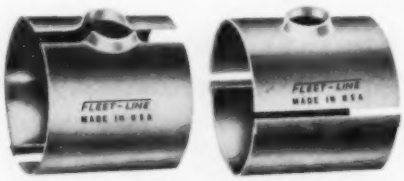
REDUCERS: Concentric and Eccentric, 1" through 30". ASA B16.9, ASTM A234. Schedules 10 to 160, X and XX heavy, stainless steel, chrome-moly and other alloys, genuine wrought iron, copper, aluminum. Special lengths and sizes without delay.

SADDLES, conventional, and for pressure vessel heads. Nozzle sizes from ¼" through 24" with skirts to any size. FLEET-LINE saddles weld neatly into place in much less time and with much less welding rod.



FULL-ENCIRCLEMENT SADDLES, nominal pipe sizes 2" through 36". Five types.

REDUCING TEES, Forged Steel, 8" through 30".

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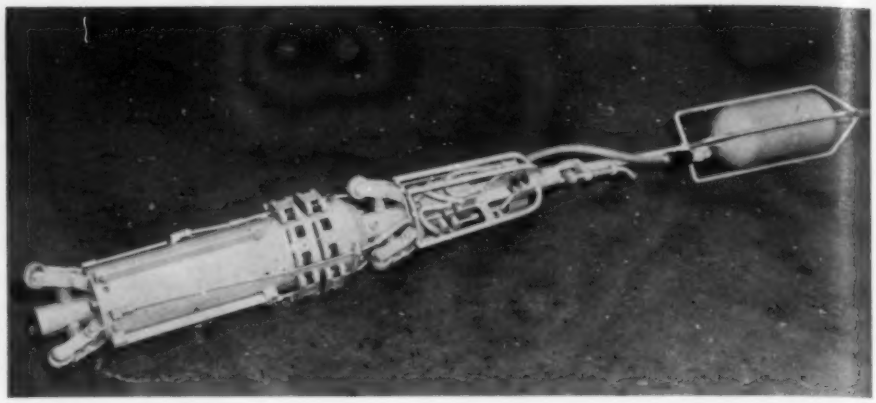


Small Clamp

A pneumatic line-up clamp for 8-inch pipe has been developed by Crutcher-Rolfs-Cummings, Inc. The small unit measures only 38 inches long and weighs 80 pounds. It has the air tank on the control rod which gives it maneuverability. Roller shoes roll pipe into round; there is a spring return on the roller shoes.

Pneumatically controlled heads operate independently for quick positive line-up. Clamp is equipped with 325 cubic inch air reserve tank which is large enough to permit several line-ups without refilling.

(This item supplements Crutcher-Rolfs-Cummings, Inc., data on pages 118-119 of the Pipe Line Catalog, Third Revision.)

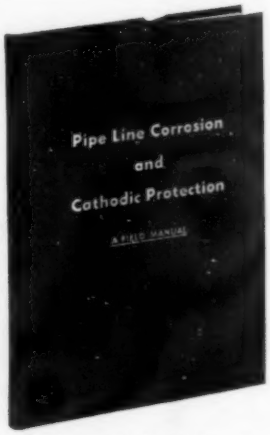
For more data, circle **No. E7** on Readers' Service Card, last page this issue.

Force Washer

An addition to the Lockheed Electronics transducer line is the LEC temperature-compensated force washer. They come in standard bolt sizes ranging from 3/16-inch to 1-inch in diameter. Loads for these diameters range from 5,000 to 35,000 pounds, depending on bolt diameter selected.

Temperature compensation is better than .5 micro in/in/°F over a range from 50 to 250° F. Accuracies of better than plus or minus 1 percent of full scale sensitivity are held for linearity, repeatability and hysteresis.

For more data, circle **No. E8** on Readers' Service Card, last page this issue.



The most practical on-the-job manual for men concerned with pipe line corrosion.

Pipe Line Corrosion and Cathodic Protection

By MARSHALL E. PARKER

This book is designed as a practical field manual. It provides workable methods that can save you valuable time and effort in obtaining interpretive field data.

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Appendices cover: Fundamentals of Underground Corrosion, Basic Principles of Cathodic Protection. Plus . . . tables and properties of metals, attenuation equations and index.

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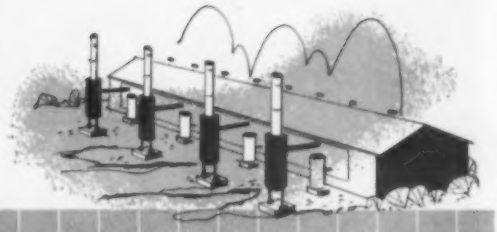
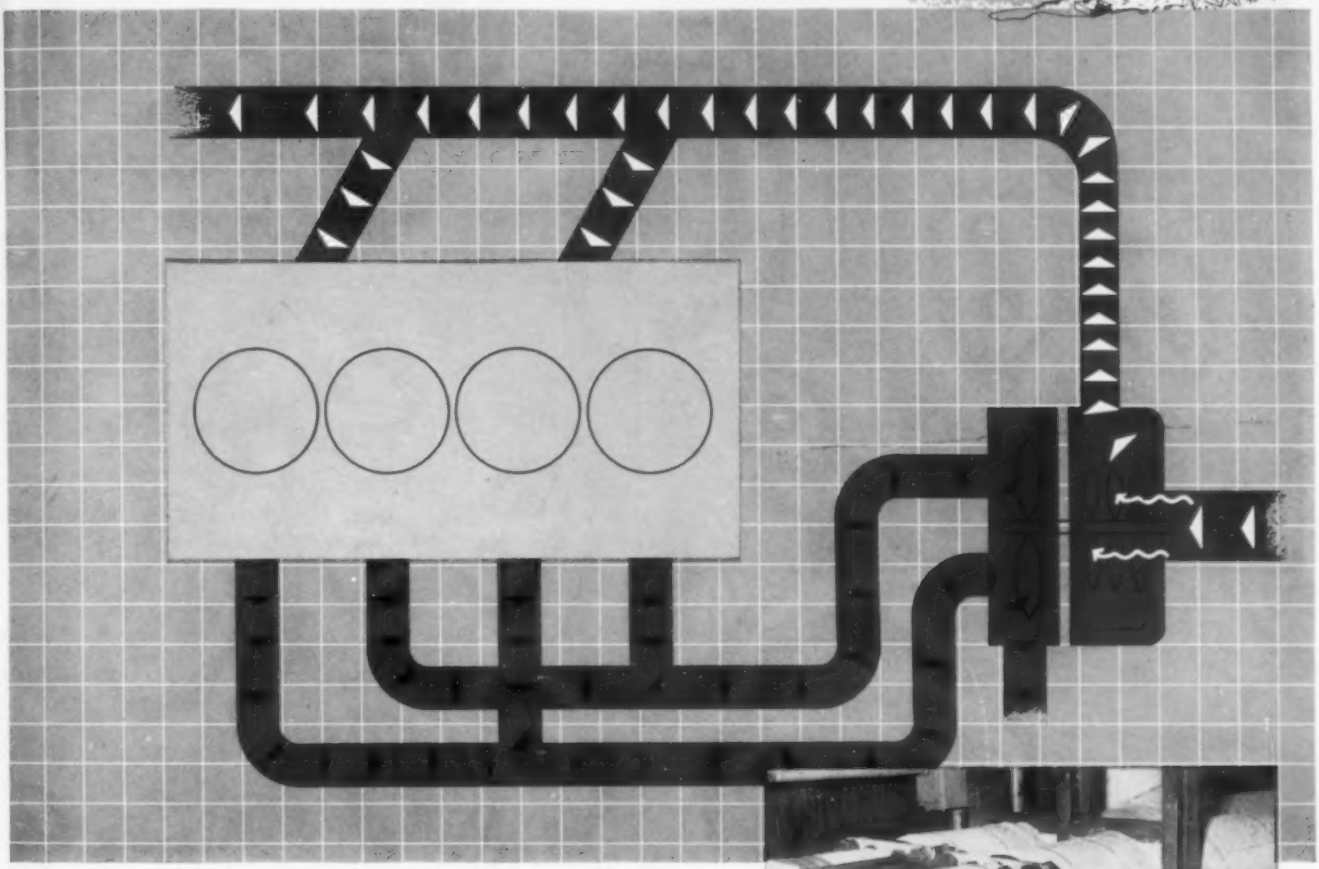
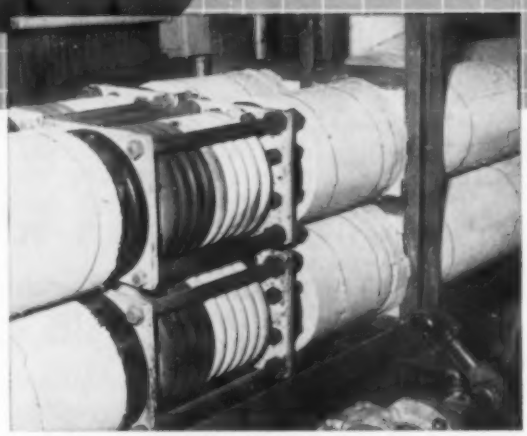




Here's a lively subject – *increasing gas pipeline capacity by turbocharging existing compressors in the field.* If you want the answers to the expansion problems that arise when the exhaust piping becomes an integral part of the operating loop, call on FLEXONICS engineers. They have the *specific* experience in this field that can mean actual dollar savings to you.



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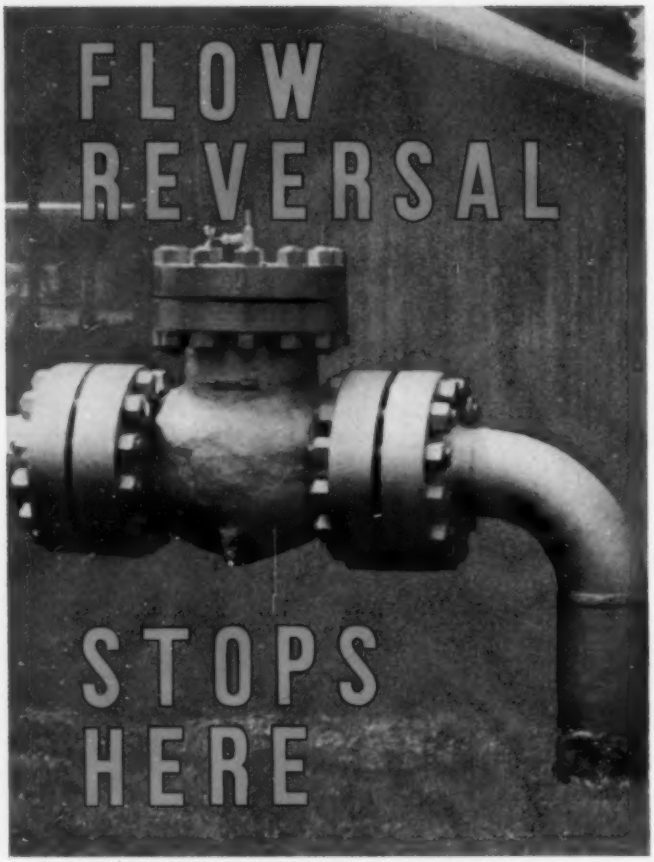
Please send me a copy of Technical Bulletin No. 175, including the detailed report on the engineering and economic aspects of turbocharging existing compressor engines to increase pipeline capacity.



Line back-surge is prevented by a positive, non-slam shut-off of the Daniel piston-controlled check valve. The "floating" piston rides well above the valve seat with line surges, eliminating chatter. Safely handles compressor and pump discharges, steam, gas and vapor flows.

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the all new CURTIN OIL THIEF*

- Easy Opening
- Positive Closure
- Single Line Trip

The new Curtin Oil Thief incorporates a full-opening, side-mounted shutter valve that provides positive closure yet can be cocked with just two fingers. Tripping at any depth can be accomplished by a slight pull on the single line, or the graduated trip rod may be used to actuate the valve at a preset distance off tank bottom.

Precision construction of spark-proof, corrosion-resistant materials assures the user of long, trouble-free service. The Curtin Oil Thief is available in cadmium-plated cast brass or in all aluminum frame construction. Replaceable two-inch barrels of Tempered PYREX®, aluminum or plastic, graduated in ¼-inch divisions, are available in 12-, 16-, 18- or 24-inch sizes.

For full information write for Bulletin T-361.

*Patent Applied For

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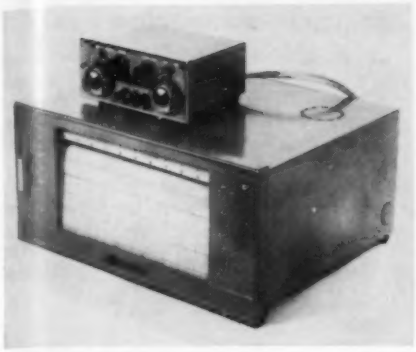
For more data on advertised products, use cards, last page.

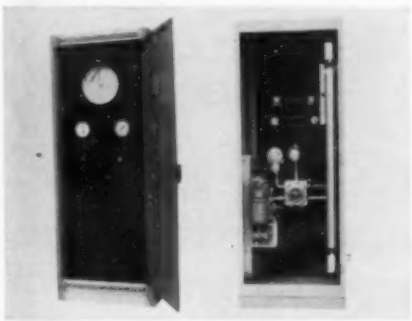


Data Recorder

A new Universal Recorder has been developed by Westronics, Inc., which can operate as a standard fixed-span recorder, or can function with one or more external plug-in modules.

The external plug-in modules contain circuitry necessary to allow this recorder to function as a strain gage, flow, temperature, pressure or potentiometer following recorder. No re-wiring or recorder is necessary to change from one module to another; modules are available for almost any recording application. The universal recorder is available in both 5-inch and 11-inch strip chart sizes in single, dual pen and multipoint models.

For more data, circle **No. E9** on Readers' Service Card, last page this issue.



Vapor Pressure Controller

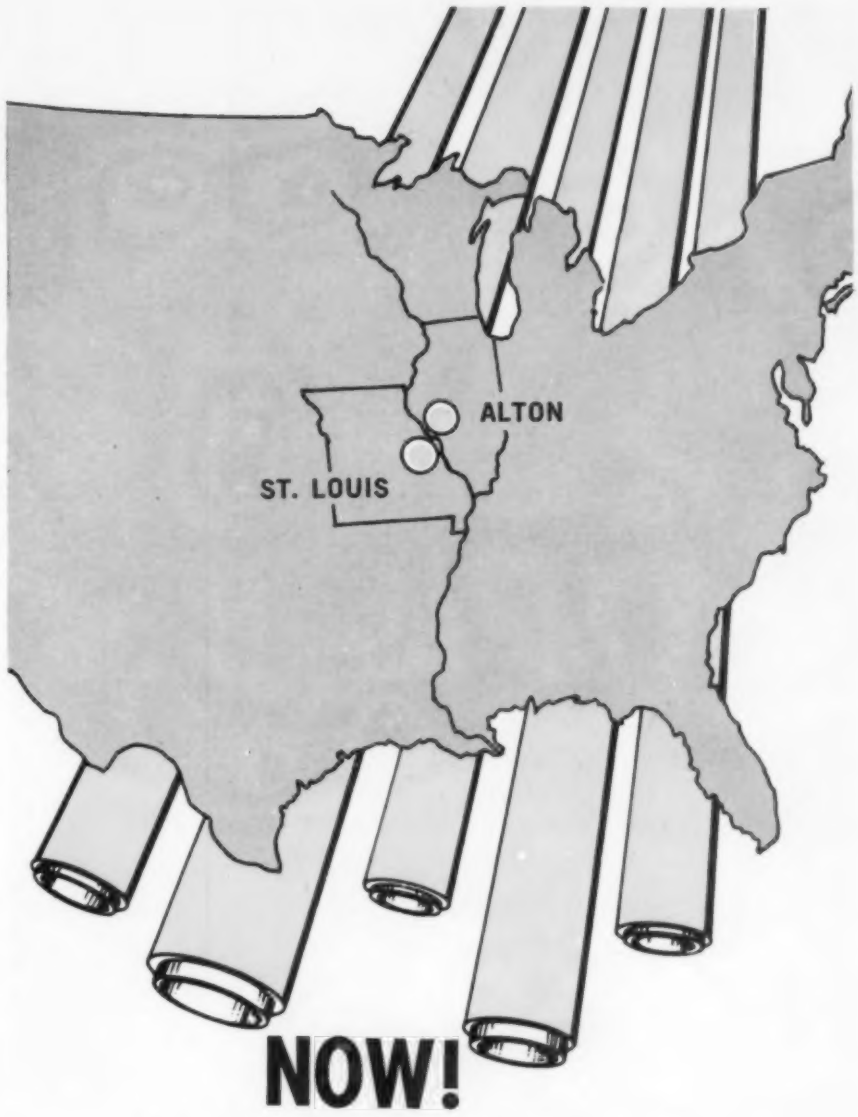
A kinetic vapor pressure controller developed by Shell Pipe Line Corporation and manufactured by Bernard Knust Company, Inc., provides more efficient operation of lines carrying petroleum volatiles such as butane and gasoline.

The instrument samples a slipstream of crude-volatile blend, determines vapor pressure, and adjusts volatile injection rate so that blend vapor pressure remains constant at a preset level. The controller recorder records changes in vapor pressure and starts corrective action in a matter of 25 seconds. It is designed for use in fail-safe provisions of trouble-free continuous operation. Datronics, Inc., markets the controller throughout North America.

For more data, circle **No. E10** on Readers' Service Card, last page this issue.

Air-Cooled Exchanger

A standardized, air-cooled heat exchanger that eliminates field assembly is available from Smithco Engineering, Inc. The "M" series cooler, pre-erected and ready for hookup is designed for completely packaged shipment to jobsite. Only field work required is to connect the piping



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from SPI's new Alton, Illinois Plant

comes **STANDARD X-TRU-COAT**

Standard Pipeprotection's new plant at Alton, Illinois has been shipping Standard X-Tru-Coat pipe to the Southwest and West since early July. Sizes available include ¾" Nom. through 4½" O.D.

X-Tru-Coat high density polyethylene plastic coating for pipe is produced under the DeKoron process — Pat. Nos. 2,447,420 and 2,467,642 — and is extruded on pipe over a pressure sensitive adhesive.

Standard Procedures assuring top quality prevail at the Alton, Illinois plant, as they have for many years at SPI's coating and wrapping plant in St. Louis. In-Transit privileges are available at both plants from any pipe mill.

Standard Pipeprotection, with the introduction of X-Tru-Coat, has continued to contribute to the progress of the oil and gas industry.

Write for complete information and for Price List Number X-1.

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For more data on advertised products, use cards, last page.

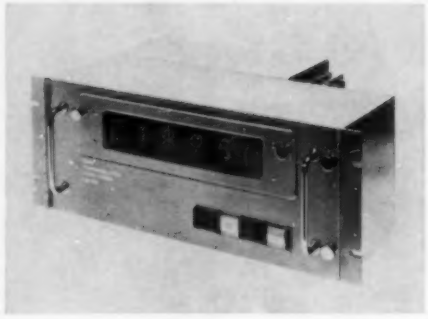
and to tie-in electrical system. The units are designed to be used either singularly or in combinations.

For more data, circle **No. E11** on Readers' Service Card, last page this issue.

Telemetering System

A digital data transmission system for remote display and recording of information from various types of meters on pipe lines has been introduced by Datex Corporation. The Datex SD-102 Accumulated data transmission system features error and safety checks, high reliability, and easy installation and maintenance.

The system makes it possible to record in one central location flow data from a number of points along gas, oil and water lines. Transmission can be over telephone lines or private AM, TONE, or FSK channels. The system is self-synchronizing and



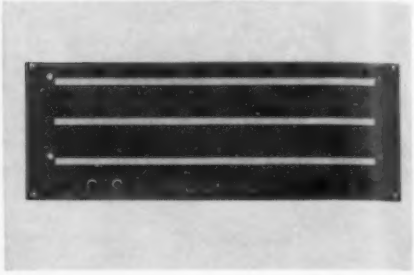
self checking, with data transmitted as a six-character decimal digit message. Readout may be obtained on demand or programmed automatically.

For more data, circle **No. E12** on Readers' Service Card, last page this issue.

Alarm-Transmission System

A complete line of electromechanical remote alarm and status transmission equipment for pipe lines has been developed by Teleplex of San Carlos, Calif.

Basic building blocks of the system are time-division multiplex coders and decoders designed to monitor up to 30 on-off or go no-go alarm or status inputs. Full alarm and status supervision is available at less than $35 per input. When an alarm or status change occurs at an unattended



station, the coder sequentially scans every status input switch and transmits a long pulse if the input is normal and a short one if the input is off-normal. The coder operates only when supervised point changes status, reducing contact wear to a minimum.

For more data, circle **No. E13** on Readers' Service Card, last page this issue.

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UTILIZE WASTED EXHAUST HEAT!

Maxim Heat Recovery Silencers can save 1,000 or more BTU per hp/hour that you are now wasting through engine exhausts.

Many industrial plants, power stations and petro-chemical installations produce enough BTU's in wasted exhaust heat to handle a large part or all of their heat requirements. Maxim Waste Heat Recovery Silencers are especially designed to turn this BTU loss into usable energy as steam or hot water.

There are valuable heat recovery possibilities in most industrial plants. For these applications or wherever there is a need to control noise or sparks, there is a Maxim Silencer designed to do an efficient job for you. Look around your plant or field installation and see if you're paying high fuel bills and wasting more heat in exhaust than you're buying in heating fuel.

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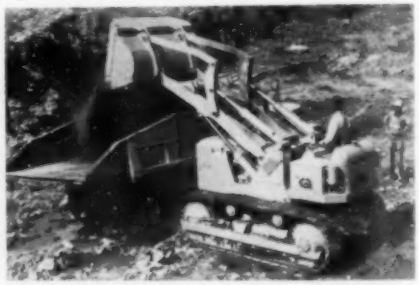


Tractor Shovel

Allis-Chalmers Manufacturing Company announces its HD-7G tractor shovel with full hydraulic power steering and oil-cooled power brakes. The unit is powered by a 100-hp turbo-charged diesel engine. The torque converter performance is combined with a new, single lever power shift transmission featuring Allis-Chalmers ground speed control governor.

(This item supplements Allis-Chalmers Manufacturing Company data on pages 37-40 of the Pipe Line Catalog, Third Revision.)

For more data, circle **No. E14** on Readers' Service Card, last page this issue.

Static Seal

A two-stage static seal in which a high yield-strength stainless steel V-ring seal is preceded by a Teflon seal is available from Pall Corporation. It is designed to operate at temperatures from —65° to 600° F and under pressures up to 10,000 psi.

The outer ring maintains seal under extreme temperatures and pressures. The Teflon seal, permanently joined to the metal component, provides a "soft seat" for leak-tight sealing.

For more data, circle **No. E15** on Readers' Service Card, last page this issue.

Multi-Stage Regulators

A new line of multi-stage regulators is being introduced by the Harris Calorific Company. The line features accurate and adjustable first stage delivery pressure that minimizes variation from static to flowing pressure. This allows second stage to control flow accurately as the cylinder pressure reduces.

For more data, circle **No. E16** on Readers' Service Card, last page this issue.

Pipe Lifting Assembly

A special pipe lifting assembly, designed to minimize the number of lifts, has been announced by American Chain Division, American Chain & Cable Company, Inc.

An Accoloy 125 double leg sling chain with master link and pear-shaped end links are attached to triangular members with several dropper chains to make up the unit. Sling hooks are attached to dropper chains and the lifting assemble can pick up several joints. It can be supplied with any number of dropper chains.

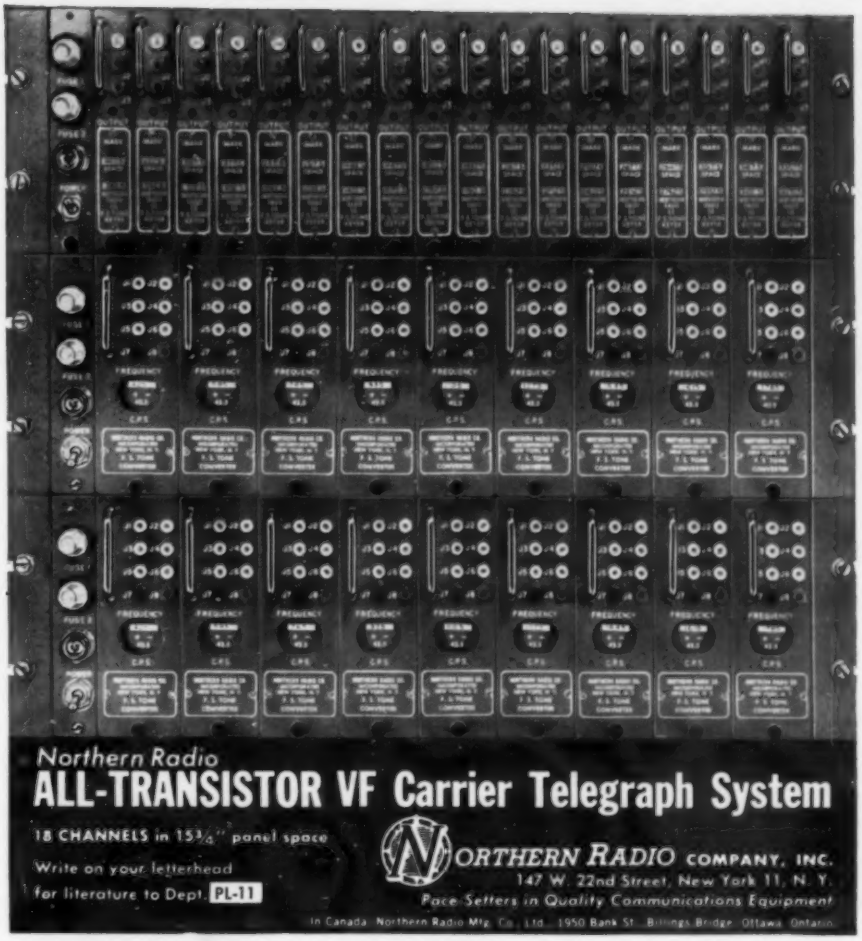
For more data, circle **No. E17** on Readers' Service Card, last page this issue.

Crab Tractor Backhoe

A new backhoe attachment designed for use with its "Crab" tractors has been announced by Napco Industries, Inc. The backhoe can be disconnected from tractor by one man in a minute's time, without special tools.

The backhoe can dig to a depth of 14 feet and dumping height is 10 feet. Unit features heavy duty double acting cylinders and is available in bucket sizes ranging from 12-inch to 36-inch. Backhoe can be powered with same hydraulic system used for front mounted 1-yard loader.

For more data, circle **No. E18** on Readers' Service Card, last page this issue.



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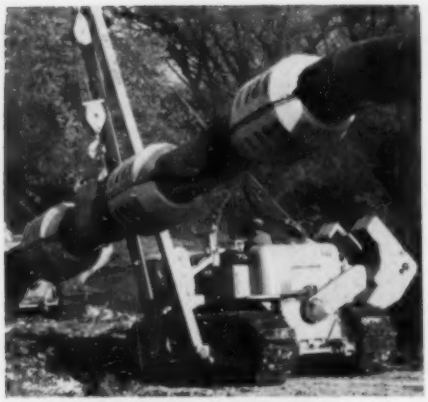

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Literature

For more data on New Equipment or copies of Catalogs and Literature reviewed in this issue, use the Reader Service postcards just inside the back cover and facing the Advertisers' Index. Simply circle code numbers of items desired—sign and mail card.

Ball Valve

A four-page brochure describes the General Kinetics Corporation ball valve. In the Ludeman Rotoflo valve the ball is rotated by an eccentric cam which lifts the ball away from the seat before it is turned to open, eliminating sliding friction and permitting use of hard metal seating surfaces.

The brochure lists complete operating and application features with specifications and line drawings. The valve is fast acting, has a full-round flow passage and provides positive shut-off.

To get a copy, circle **No. E19** on Readers' Service Card, last page this issue.

LACT Units

A booklet on lease automatic custody transfer units, has been published by Jones & Laughlin Supply Division. The brochure is illustrated with diagrams and photographs. It contains details on operation of LACT units, their features, specifications, standard and optional components and installation.

To get a copy, circle **No. E20** on Readers' Service Card, last page this issue.

Compressors

Clark Bros. Co. has issued a 56-page bulletin covering Clark Model TLA gas-engine-driven compressors of 1,700 to 3,400 bhp. Compressors are used in pipe line operations and gas storage.

In addition to performance features, bulletin describes the turbocharging system, standard and en bloc compressor cylinders and various automation systems. Dimensions and specifications are included as well as construction details, sectional views, and 36 installation photographs.

To get a copy, circle **No. E21** on Readers Service Card, last page this issue.

Plastic Lines

Detailed explanations of how to install plastic pipe for gas transmission is contained in an illustrated 28-page booklet, Gas Installation Handbook, issued by Naugatuck Chemical Division, United States Rubber Co.

It also contains data on fittings for plastic pipe; AGA recommendations for plastic pipe installations; operating pressures and temperatures; specifications on plastic pipe for gas transmission and information on the materials.

To get a copy, circle **No. E22** on Readers' Service Card, last page this issue.

Meters

Rockwell Manufacturing Company has issued a 28-page catalog on its complete line of meters and accessories. It includes descriptions, illustrations, specifications and dimensions of pipe line meters, production, industrial tank truck, oil marketing meters, packaged units for volatile liquids and the Turbo-Meter. Electrical impulse contactors, key control panel, air eliminators, line strainers, temperature compensators and other accessories are described.

To get a copy, circle **No. E23** on Readers' Service Card, last page this issue.

Temperature Controls

A design catalog sheet has been issued by United Electric Controls Co. covering Type E36N, indicating temperature control.

New high temperature (0 to 1,000° F) indicating control (Series 900) plus low cost compact short range indicating temperature control (Series 800) are both featured. Applications, construction features and control range are described.

To get a copy, circle **No. E24** on Readers' Service Card, last page this issue.

VOSS VALVES will mean LESS MAINTENANCE FEWER SHUTDOWNS for your COMPRESSORS

Voss Valves are made to specification, machined from solid stock (not cast)—using best alloy steels; for corrosion condition—stainless steels, such as 410, 18-8 or non-ferrous alloys—monel, inconel, etc. Plates are machined (not stamped) and ground for precise close tolerance fit; are dimensionally stable . . . ductile . . . resist fracture, high temperatures and corrosion . . . withstand fatigue. Springs of heavy rectangular sections and large diameters add to dependability and safety.

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- less power consumption
- normal discharge temperature
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- utmost safety
- lower operating costs

For detailed proposal send name, bore, stroke and speed of machine.

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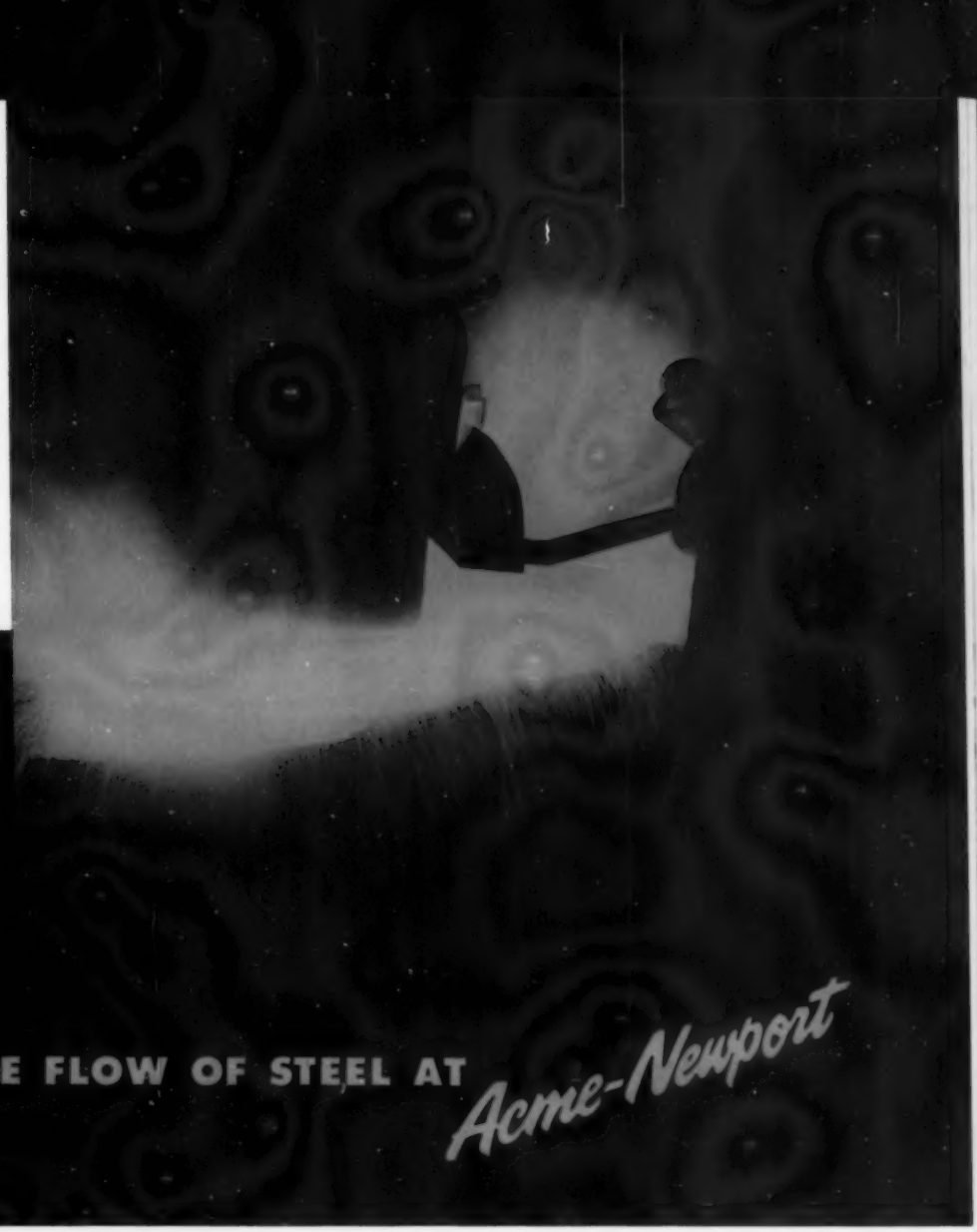

THE FLOW OF GAS and OIL BEGINS WITH THE FLOW OF STEEL AT Acme-Newport

Every length of Acme-Newport electric weld line pipe undergoes exacting quality control through every process, from steelmaking formula to final electronic inspection. This 77-year-old basic steel producer makes 4″ and 6″ pipe that always is true round, with uniform wall thickness, standard or thin. Bends readily, welds perfectly, installs and functions trouble-free, provides long uninterrupted service in the field. Be sure you get pipe that conforms to your every specification and that of API and ASTM. Buy Acme-Newport!

Steel

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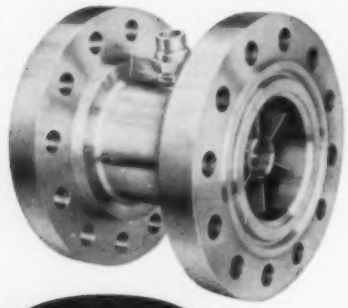
	.156″	7.25
	.188″	8.64
	.219″	10.00
	.237″	10.79
6⅝	.156″	10.78
	.188″	12.89
	.219″	14.97
	.250″	17.02
	.280″	18.97

COX TURBINE FLOWMETERS



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Here's why:

- *Low first cost*
- *Low maintenance*
- *Easy to install*
- *Readily replaces existing totalizing meters adding flow rate and control*
- *Sustained meter factor over wide range of products and flow rates*
- *Excellent repeatability*
- *Suitable for totalizing, recording, telemetry, control and blending applications*

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Are you aware of the tremendous difference a small amount of Unicor can make in pipelines and crude units?

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By adding a small amount of Unicor to your product—10-20 parts to a million—you prevent product contamination, profit-robbing corrosion; assure maintenance of full-flow capacity and output.

Furthermore, use of Unicor substantially reduces filter cleaning and replacements, scraping operations, power costs and expensive downtime.

What Unicor does for tanks and pipelines it also accomplishes in crude units and other refinery equipment. For detailed information, write to our Products Department.

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Special report to users of Caterpillar D7, D8 and D9 Tractors:

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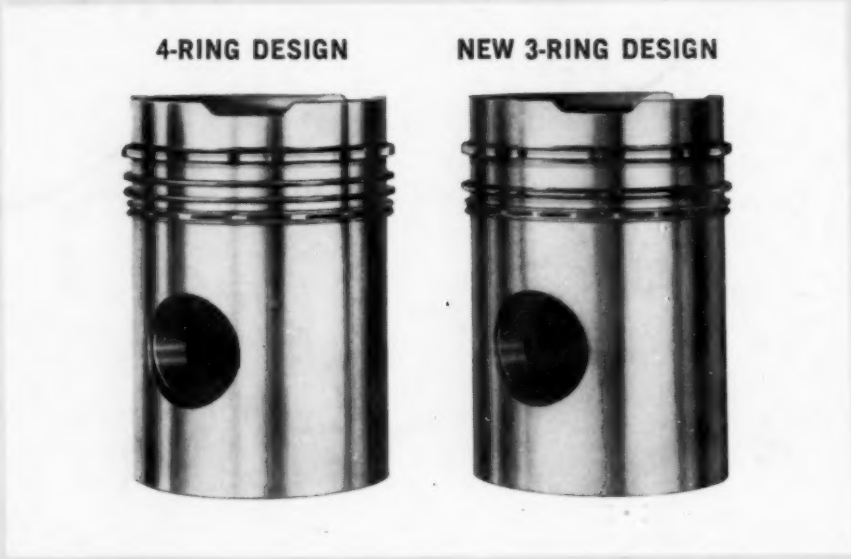
New Piston and Ring Combination Cuts Oil Consumption 33-50% ...Lasts Hundreds of Hours Longer!



What makes it so different? Look at the two Caterpillar-made pistons. Notice in the new design that *both* compression rings are now deeply seated in grooved cast iron (indicated in yellow) instead of only the top ring. Since cast iron is able to resist groove "pound out," both compression rings are held firmly *longer* in the correct position for maximum ring-to-liner sealing. Compression loss and blow-by *behind* rings and around grooves is delayed hundreds of hours, too.

The new intermediate compression ring is a "twist" ring, so-called because it changes position in the groove during the power stroke. It actually "twists" so its face has *greater sealing area* at the liner than regular rings—reducing the number of compression rings normally required. At the same time, it thins the film of oil left by the regular oil control ring. This leaves less oil to burn away which contributes to the new piston's better oil control and longer ring life.

All rings now have a new look, too . . . *each and every* face is thickly chrome plated against wear. They are also "bright lapped" to such brilliance that any flaws can be easily seen and the faulty ring rejected. Such quality control assures almost perfect seating right from the start, eliminating break-in blow-by, slobbering and scuffing.

Cost? Pistons with the *extra* cast iron bands cost *slightly more*, but ring sets are less! Once you change over, your tractor maintains its power longer, your fuel and oil bills go down, and your next set of replacement rings will be less. Your Caterpillar Dealer has them in stock now.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

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